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ON THE COVER

Finding a spectacular specimen like this crystallized amethyst from Guerrero, Mexico, is every field tripper's dream. Try your luck at the locations featured inside. (Photo by Harold and Erica Van Pelt/Bill Larson specimen)

Miller Magazines, Inc.

Rock & Gem (ISSN 0048-8453, USPS 486-290) is published monthly by Miller Magazines, Inc., 290 Maple Ct., Ste. 232, Ventura, California 93003-0517, telephone (805) 644-3824. Periodicals postage paid at Ventura, CA 93006, and additional mailing offices. Single-copy price $3.99. Subscription in U.S.A. and possessions: 1 year (12 issues) for $24.00; 2 years for $42.00; 3 years for $54.00. Add $9.00 per year postage for Canada and all other foreign countries. Submission of articles and photos by our readers is welcome, but we can accept no responsibility for loss or damage to unsolicited editorial contributions.

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Printed in U.S.A.

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POSTMASTER: Send address changes to
Rock & Gem,
P.O. Box 469113, Escondido, CA 92046-9113
or RockAndGem@pcspublink.com

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Collecting Massive Minerals

Crystals without Faces Can Still Be Handsome

Story by Bob Jones

JEFF KURTZEMAN

This carved piece of malachite shows the radiating needle crystal patterns that formed the original undulating surface.

The more spectacular exhibits in mineral museums are those with wonderfully showy crystal groups, each crystal a geometric wonder of shape and form. Often blessed with brilliant color, well crystallized minerals are the darling of any mineral show, personal collection, and museum display.

While such beauty is eye appealing, the specimens with the perfectly formed, geometrically shaped crystals of fine color always cost the most at gem and mineral shows. Because of the high cost of showy minerals these days, most collectors are having a hard time adding anything significant to their collections.

Other factors such as vibrant color, unusual, historical or popular origin, and rarity can make specimens cost even more. As values go skyward, it is not unusual to see fine crystallized minerals selling for as high as five figures. I don't know about you, but I can't afford anything like that.

Luckily, there is a cluster of attractive, often colorful and showy minerals that are not as costly as well crystallized specimens. These are minerals that lack crystal faces. I don't mean broken chunks of mineral best left in the science lab or on the dump. I'm talking about are those minerals that develop in apparently massive shapes and forms, yet can still be attractive and colorful. They show well, and when displayed together, they are a very unusual, yet appealing, sight.

I scanned through just one popular collector book on mineralogy and found more than 50 mineral species that fall into this noncrystal category. Most of them form fine crystals, but can also be found in a massive form such as botryoidal, reniform, mammillary, and others. These terms are flexible, and their use depends on who is looking at the specimen. I tend to use the terms botryoidal and mammillary, but seldom reniform to describe a mineral. The reader should understand these terms are almost interchangeable, since there is no hard and fast rule that distinguishes one from the other.

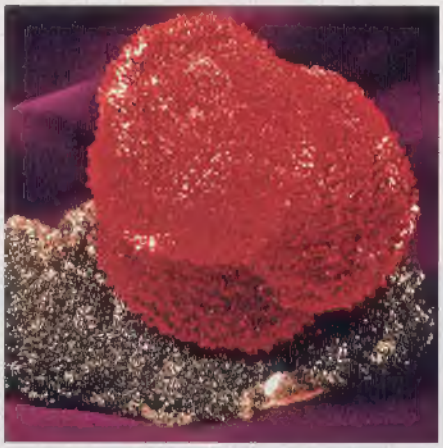
Earlier, I used the phrase "apparently massive" when referring to this group of minerals. I used that qualifying term because it implies a lack of any crystals. This is technically not true, since what appear to be massive minerals are still composed of crystals, albeit crystals that are hardly distinguishable within the mass.

A good example of a mineral that garners fairly high prices these days is smithsonite. It can be colorless or a whole range of very attractive hues—blue, green, yellow, pink, and white—and sometimes a piece will show more than one color. Of course, smithsonite forms superb trigonal crystals, but the showy crystal groups cost quite a bit. Fortunately, there are types of smithsonite that can be less costly, but just as attractive. These are the specimens that form in reniform, mammillary or botryoidal groups. The cost of some massive smithsonite can also be excessive. Fine, blue mammillary smithsonites from the Kelly Mine near Magdelena, New Mexico, are pricey, as are the few specimens still around from the Greek deposit at Laurium. These classic massive specimens demand a high price because they are colorful and are no longer being mined. They have long been considered among the better examples of this zinc carbonate.

BOB JONES

Bright blue, sometimes greenish, botryoidal hemimorphite comes from the mines around Santa Eulalia, Chihuahua, Mexico.

Fortunately, there are smithsonite sources that are not considered classics, so their massive material is less costly. Currently, Mexico is producing a lovely assortment of colorful, massive smithsonite in a variety of hues. It ranges from gray-white through several shades of color and is found in showy botryoidal masses. The largest one I've seen from the more recent producing area at Choix, Sinaloa, weighed about 75 pounds. These undulating specimens range from pink to blue to violet and are still available for sale. This material, though soft and subject to parting, even makes interesting lapidary material, patterned and colorful. Some specimens show more than one color, which makes them even more attractive, but are still priced far less than the classics and the superbly crystallized smithsonites from places like Tsumeb, Namibia.



BOB JONES

Showing only tiny crystal faces, this spherule example of rhodochrosite, known as the Strawberry, is one of the mineral's most famous specimens.

Malachite is a mineral that is commonly seen as massive mammillary chunks. It lacks visible crystals, but is commonly seen in any one of a range of greens and may even approach black in color. Unlike smithsonite, which tends to be translucent, malachite is opaque. What makes it exceedingly popular is its penchant for occurring in variegated light- to dark-green layers. By cutting malachite at different angles, very pleasing color patterns can be exposed. When malachite is cut across the fibrous structure, a chatoyance, or scattering of light, is often revealed that rivals smithsonite in showiness.

Seen on edge, massive minerals with smooth, knobby or undulating surfaces look fibrous, with radiating, needlelike patterns that usually show banding or layering and vary slightly in shadings of one or more colors.

This radiating fibrous pattern, seen on the edge or side of one of these minerals when broken, is in itself interesting. I mentioned that these minerals technically do not lack crystals. Consider a mineral composed of a bunch of diverging needles that spray off in all directions from a common starting point. We know it formed when the crystal needles grew rapidly in one direction only. Now, squeeze that spray of crystals so every needle lines up tightly against its neighbor. Now it takes on the appearance of a fibrous growth.

In nature, that's exactly what happens with these mammillary, botryoidal minerals, except they are not pressure squeezed. Rather, while the needle crystals would love to diverge into sprays, they can't because they are simply so tightly packed they can only grow in one direction. What starts out as a fanlike growth ends up as a solid spray pattern of needles in which the individual needles can hardly be distinguished from one another. In such a case, discrete crystals are not possible, and you end up with a growth-restricted radiating pattern.

You probably have wondered why such crystals grow radially. Why didn't the crystals simply grow parallel to each other? Why do they spray apart? One reason is that as the crystals start to develop, they tend to be a little thicker at the base. That tendency affects the direction of growth for each crystal. But, when crystals start to grow, they need a starting point, called a point of nucleation.

BOB JONES

Hemimorphite from Durango, Mexico, makes interesting carving material.

For example, even a raindrop needs something around which to grow. Most rain starts out either as hail or as snowflakes high in the atmosphere. Each of these forms have to cluster, or grow, around something. Enter dust!

As warm air, which holds more moisture than cold air, rises and cools, the dust in the atmosphere acts as a point of nucleation to which submicroscopic water droplets begin to cling, slowly building into a larger droplet or snowflake until gravity takes hold.

continued on next page

Similarly, mineral crystals, including needlelike crystals, have to have a starting point, something to cling to as growth begins. Where crystal growth in a vein or pocket is concerned, this point of nucleation may be nothing more than the rough edge of the pocket or seam wall. Or it can be a submicroscopic cluster of the mineral's molecules that have already gathered together, drawn by affinity to each other.

Affinity can explain free-growing crystals, which we find unattached to rock or anything else. Such crystals are usually doubly terminated and perfect in form, or nearly so, since they have grown without interference.

Not all crystals form attached to something else. Crystals able to grow equally in all directions are often called "floaters" by collectors, as they have developed while free-floating in a mineral-rich solution. But how can that happen? We've been taught in school that likes repel and opposites attract, and that's true when talking about electricity. But mineral molecules tend to have an attraction—we call it affinity—for each other. As the individual molecules of a mineral are floating about in a solution, they gravitate toward each other, and when they come into contact with a like molecule, they cling to each other in a slow cycle of growth.

While the attraction starts out as chemical, the molecules actually attach electrically. The important requirements for crystal growth are space to grow, availability of material, and growth time. The more growth material available, the larger the crystals can be, given space to grow. And the longer time the crystals have to grow, the bigger they can get, again given enough space and material. The "space" does not have to be open space as we think of it. It can be solution-filled space or even a semisolid material that is easily pushed aside by the developing crystal. This explains why discrete, sometimes huge crystals, are found in crystal pockets, pegmatites and veins. It even explains why we find crystals like garnets that obviously did not form in an open space, yet are perfect in form, in what is now solid metamorphic material. Because of heat and pressure, that rock was not so solid during crystal growth.

But does that explain what we see when we look along the edge of a broken mammillary mass like malachite? It does. The difference is that one of the necessary conditions isn't there: space!

In the early years of the evolution of chemistry as a discipline, the discovery of affinity is what helped modern scientists to grow synthetic crystals. Hang a slice of quartz in the right environment, laced with dissolved quartz, and the slice will eventually develop into a large crystal. This was the method used to develop synthetic quartz crystals for use during World War II. Given the notion of the affinity of like molecules, it is easy to explain how, once a few molecules collect, more and more molecules of the same mineral add to crystal growth.

In the case of our subject minerals, there is a problem. With some minerals, several micro-crystals will start to grow from a common point of nucleation on a rock or pocket wall. These crystals, restricted from growing in every direction, are forced to grow only in one direction, usually quite rapidly. They crowd each other, weakly bonding as they grow. The result is needlelike crystals that form in a radiating pattern or fan. As these fans grow next to each other, they tend to bond while interfering with growth fans next to them, causing lovely, intergrowing, fanlike patterns. Since they grow more or less simultaneously, their length ends up about the same, but because they are at different angles to each other, the final surface is not flat, but curved or rounded, to which form we apply names like botryoidal, mammillary or reniform.

BOB JONES

Chalcopyrite develops interesting shapes when it forms in small, radiating crystal spheres.

This same growth pattern can actually cause a complete sphere to develop if only one is forming without interference. Usually, these radiating clusters end up crowded together to form partial fans and undulating shapes. These massive shapes are even more interesting when there are slight variations in the chemistry of the forming solution. This can cause slight variations in the size of the radiating needles, the thickness of the layers, and the color of each fan layer. The growth angle also creates this light-dark illusion. This is what gives malachite and other such minerals their variegated color, shimmer, or chatoyance.

Mineralogists recognize that not all minerals that form this way have a similar undulating surface. Therefore, they have devised a group of terms that, though subject to viewer interpretation, do generally apply to these minerals.

The general terms are mammillary, reniform and botryoidal. Each relates to the undulating surface of an apparently massive mineral according to the size of the rounded surfaces. Mammillary refers to the larger "rounds," and reniform, a term describing a kidney shape, refers to those that are less round. Smaller shapes are said to be botryoidal, meaning grapelike. There are no hard and fast measurements that apply to the use of these terms; they simply denote in a general way the undulating surface of the mineral.

There is yet another group of terms applied to minerals showing little or no crystal form. With a hand lens, you might see microscopic crystal faces, which give the surface sparkly highlights, but the overall appearance of these minerals is something other than the usual geometric form we call crystals. Dendritic denotes a branching, or treelike, form; globular refers to small spherules in the structure; acicular means hairlike; and stalactitic describes more or less long, slender, fingerlike projections that lack crystal form. Finally, there are reticulated crystals, clusters of slender crystals that form regular angular joints which, while lacking obvious crystal faces, follow the geometric pattern of a crystal system. Except for reticulated crystals, which can be very pricey, these forms can sometimes be less costly than well crystallized specimens of the same species.

Of course, there are many examples of specimens in these forms that are really costly. Yellow botryoidal smithsonites from Sardina came to light over a century ago and is seldom, if ever, seen for sale. When it does show up, it is usually priced very high. Much of this material occurred in fine, banded stalactites, which were often cut across the grain to make bright yellow-banded discs showing a radial pattern from the center to the outer edge.

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Collectors are very familiar with the less expensive radiating discs of several minerals, like the pyrite "suns" from the coal fields of southern Illinois. When stalactites or stalagmites are sliced across their length, the resulting discs show a pattern of radiating lines of crystals from a common hollow center. In cave formations, this is a function of water dripping down that central core and depositing micro-crystals on the outer surface. However, the radiating pattern of pyrite suns results from the fact that the crystals develop in a thin crack, so they can only grow in two directions from the point of nucleation.

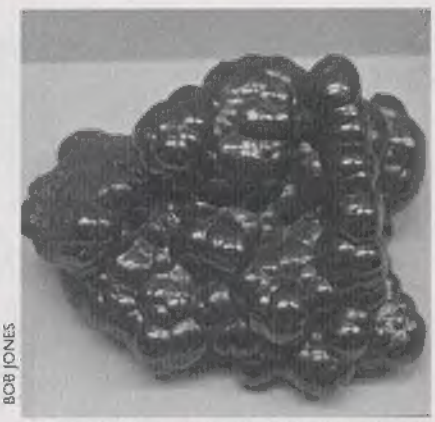
One other mineral worth mentioning here, though it actually does show crystal faces, is drusy quartz. The term drusy means the surface of the specimen undulates, but is not smooth. Rather, it is covered with the tiny points of crystal terminations that are tightly clustered together to form a continuous, but rough-surfaced, mass. Drusy quartz, provided it isn't some outrageous color, may well be the least expensive of this entire group simply because it is so common. The prettiest type of this material may be clear quartz points covering bright blue chrysocolla; a nice specimen of this material is usually not out of reach.

One of the very common minerals that develops a lovely mammillary to botryoidal form is hematite. It is usually a lustrous black, but is sometimes coated with a dull reddish brown alteration "skin." Huge quantities of this material have been mined as an iron ore; the Mesabi Range yielded multiple tons. Unfortunately, because botryoidal hematite was not a hugely popular collector mineral when the range was in full production, not a lot of this material was saved. The layers that formed such massive hematite were sometimes so thick that the banded layers could be a foot or more from the point of nucleation to termination. The bonding along the fibrous, radiating needles that make up these layers is always weak, so these thick chunks could be split vertically, and long, tapering, sometime curving splinters with a rounded top tapering to a point at the opposite end could be had. Some of these splinters exceeded a foot in length.

The classic botryoidal hematite was mined in the Cumberland region of England, where huge iron mines supplied the metal ore for the growth of the Industrial Revolution. These lustrous, black, lumpy masses are very attractive and can still be found for sale. Some have a dull reddish surface where the hematite has altered slightly. This oxide coating can be polished off, turning an average piece into something quite pretty. Most attractive are the botryoidal specimens whose surfaces, while typically undulating, sparkle with bladed hematite crystals just a fraction of an inch high that formed as a secondary growth after the mammillary material had ceased to grow. Some of these lovely specimens even have clear, doubly terminated quartz crystals on the hematite.

Hematite deposits in various other places have produced lesser amounts of this attractive material. Cerro de Mercado in Durango, Mexico, is better known for its lovely gemmy yellow fluorapatite crystals, but mammillary hematite, usually rather dull, has been mined there in quantity. It was mined as an ore, so specimens seldom survived.

One of the oddities of the mineral world is seen in hematite, as well as some other minerals like calcite and aragonite. These minerals can develop small spherules in tightly connected clusters that cover the surface of the matrix upon which they formed. These tiny ball-like shapes, which are really completely enclosed radiating spheres of the mineral, are called oolites or oolitic material, since they resemble clusters of eggs.



BOB JONES

The hematites from Cumberland, England, are perhaps the finest to be found anywhere.

Malachite is undoubtedly the best known mammillary mineral around. This copper carbonate rarely forms in discrete crystals (large crystals that are free-standing). True, there is an abundance of fine malachite crystals, some of them 4 and 5 inches long, in intergrown clusters. These are not referred to as primary crystals in the mineral trade. They are actually pseudomorphed after azurite. Primary malachite crystals are discrete, visible forms. Both discrete and mammillary forms developed from the initial melt or solution, but it adds to the value of discrete malachite crystals when dealers refer to them as "primary" crystals. Usually, such crystals are small, under ½ inch. Other so-called primary malachites are free-standing, hairlike growths covering matrix.

Just imagine those same hairlike growths so crowded together they can only grow upward or in one direction. If they all start from a common point, they radiate out, forming a fanlike pattern. They continue to develop until something interferes with their growth. They may simply run out of molecules to attract, or they may run into the radiating growth next to them. Or the solution may change slightly, and another mineral is deposited on the terminations or top surface of the radiating group, stopping crystal growth. This often happens with malachite.

Sometimes, the change in the growth solution is so dramatic that an entirely new copper mineral forms, often azurite, which explains why superb specimens of banded malachite-azurite have been found. These are rare and pricey. More often, the copper mineral that forms and interferes with growth is a black oxide mineral. When this happens, there is little or no bonding between the malachite and the second mineral. When the specimen is struck or stressed, the second mineral separates from the malachite. I've even seen large mammillary malachite pieces where you can lift an upper section off a lower section of the same mineral, like a hat off a dummy's head, because something has prevented the layers from bonding!

This lack of bonding between layers of malachite or any other mammillary mineral can create a real problem for the lapidary who wants to work with large sections of these minerals. Applying pressure during cutting, shaping and polishing can cause the specimen to part, ruining the project. Close examination of any large mass of such material helps avoid such a problem.

Massive malachite seems to be all over the place thanks to the copper mines in Africa. These copper deposits, originally called the Roan-Antelope Belt, host dozens of mines, some of which have been producing wonderful, rich green, banded botryoidal to mammillary malachite. In some cases, the malachite is coated with a darker copper mineral. Some specimens of the green mineral even have a light coating of pale blue. The African malachite rivals anything found in other deposits, and because it is currently abundant, this is a good time to get specimens for your collection.

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Collecting Massive Minerals *from page 16*

Among the most amazing deposits of malachite ever found are those in Russia, which came to light a couple of centuries ago. Peter the Great, circa 1700s, made sure a lot of this material was saved. He declared that anything found in the ground was the property of the czar. Masses of banded malachite were found that weighed several tons. The material was pretty vuggy, but still suitable for lapidary work.

Because of the vuggy condition and the frequent parting of layers in the malachite, the Russian artisans developed a style of overlay on limestone or basalt objects or forged-copper cylinders, covering them with small, thin pieces of malachite in a matching mosaic pattern. This Russian Mosaic technique, as it is often called, makes the object look like solid malachite, for you can hardly see the joins.

The botryoidal material you will most likely find when out collecting in the Western United States is chalcedony, the cryptocrystalline form of quartz. That name tells it all. The material is made of quartz crystals, but they are "hidden" because they are so small as to be virtually invisible to the unaided eye.

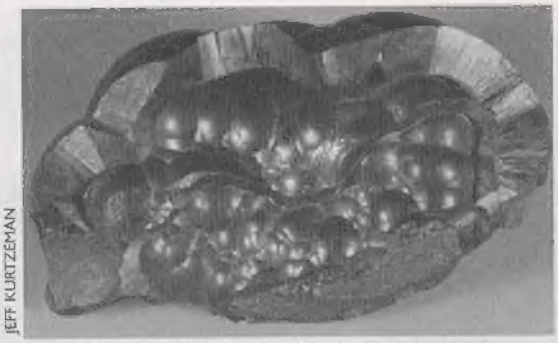
Pure chalcedony does not come in colors. It is usually white to gray, though there have been sources of blue chalcedony; the color is probably due to included water that scatters the light. But chalcedony becomes an altogether different creature when mineral salts invade it.

Chalcedony is composed of submicroscopic quartz "needles" that radiate from a common point of nucleation. As is common in quartz, these tiny crystals tend to twist slightly. It has been suggested that about 30,000 such crystals form an inch-wide band of the mineral. With that many crystals to the inch, you'd think chalcedony is impervious to invasion. Not so! All sorts of mineral salts can invade the silica.

If nickel salts get into chalcedony, the mineral takes on a lovely green color and we call it chrysoprase. Light-blue chrysocolla is called gem silica. And when it forms in colorful bands, often with fortification and other patterns, it's called agate. Most agates do not show an undulating surface, as they generally form inside gas pockets or seams, and the outer surface does not develop free of interference. Oddly, agates that have been sliced sometimes show a banded and often colorful undulating interior pattern. Adding something like that to such a collection would not be out of line at all!

How common is chalcedony? You can still find small pieces of it scattered over the Southwest desert floor, especially in areas of volcanism. Called desert roses, these usually white pieces of quartz boast a lumpy, rounded surface. Many pieces fluoresce a brilliant green, thanks to a bit of uranium salts. Still others are tan to dark brown because of included iron oxides. The best of all chalcedony gems are those that show a play of color; we call them fire agates. A good lapidary can carefully polish the rounded, grapelike surfaces of the better fire agate to expose and highlight their superb flash of colors.

Fire agate is the product of basaltic rock. Formed in open seams after the basalt has cooled, fire agate can occur in sheets of considerable size. I've seen pieces in place that measure to a foot across. It's very difficult to get such a large piece out because it rests tightly on very hard basaltic rock and is easily shattered during removal. Much more common are small 1-inch to 3-inch pieces of chalcedony fire agate. The best and easiest collecting is in the scree or gravel slopes around the base of a basalt formation known to produce good fire agate, though the pieces you find tend to be small.



JEFF KURTZEMAN

This hematite shows a reniform top surface and a botryoidal interior surface.

Currently, Mexico is producing lovely and very colorful hemimorphite that is mammillary in form. Usually a bright blue, but sometimes greenish, the hemimorphite comes from the mines around Santa Eulalia, Chihuahua. Other colorful hemimorphites have come in quantity from the Santo Nino Mine near Guadalupe Victoria in Durango. For a period of time, huge amounts of material were mined and saved as specimens. Most of it was a lovely blue. Some of this material is still seen at shows, but the source no longer produces. Some of the earlier material from here was stalactitic, and could be sliced across the long axis to make lovely blue radiating discs.

In Arizona, the 79 Mine near Hayden has been well known as a source of superb botryoidal hemimorphite. Commonly a lovely green color, this material lines open seams and vugs and shows a nice undulating surface that sparkles with tiny crystal faces. The mine has been worked for specimens off and on now by diggers who have a collecting contract on the property.

Cassiterite is the primary ore for tin and usually occurs in attractive dark-brown to black crystals. It also occurs in banded masses that show every type of undulating surface. Since cassiterite occurs only as a black to brown mineral, when it forms in layers of alternating colors it resembles wood grain. Therefore, it is referred to as wood tin.

A whole series of mines in Mexico, primarily in the state of Durango, have produced huge amounts of wood tin. The states of Guanajuato and San Luis Potosi have also been major producers of wood tin. In fact, the mines of Mexico have undoubtedly produced most of the wood tin that survived the crusher. Some Mexican mines have interesting names, like the 29th of June Mine. I wonder what happened that day!

Wood tin ranges in form from mammillary to reniform to botryoidal; the last is the most common surface feature. When it is broken so the banding can be viewed, pieces usually show alternating, curving and undulating varicolored layers of brown with black interspersed. Unfortunately, because the material is a valuable ore of tin—in fact, the major ore of this white metal—the wood tin joins other forms of cassiterite in their journey to the crusher and smelter!

One of the more unusual forms of cassiterite found in Mexico resembles a matted mass of sheep's wool, and is called wool tin.

The tin mines of Cornwall, England also produced very lovely brown banded wood tin but these mines are long since played out and not much material has survived.

My favorite mineral that shows the forms described here is rhodochrosite. This superbly colored manganese carbonate has been mined in amazing red crystal groups, but it has also been mined in grapelike plates from Japan and in stalactitic form from several minor sources and one major source, Catamarca Province, Argentina. This remarkable metal deposit has supplied the world with the finest banded, stalactitic rhodochrosite in huge quanti-

ties. Usually, its massive material has a pale white to tan to pink rough coating on it, but internally, some of the most beautiful radiating bands of varicolored red to pink rhodochrosite ever seen occur here.

The most attractive Catamarca Province rhodochrosites are the bright-red to pink stalactites. Slicing them across the long axis produces superb discs showing a radiating pattern. When backlit, these thin discs glow a brilliant red and resemble stained glass windows! The latest use of such discs is to mount them in curving brass holders so they can be put in front of a light source or used as a very attractive desk decoration. Sometimes, the slices are used as tiles in bathrooms, where pink or red décor is not too garish. Sliced discs of rhodochrosite are very expensive and out of reach to most of us.

The amount of banded rhodochrosite in Catamarca Province must be immense, as it has been coming from the site since the early part of the 1900s. Ashtrays, bookends, eggs, cutlery handles, and carved animals are just a suggestion of the variety of uses made of this lovely material.

The banding of this rhodochrosite ranges from pale pink to rich red. Sometimes, pieces also have lovely tan to brown bands of siderite alongside the rhodochrosite, making a nice contrast.

Among the zeolite minerals, there are several species that form in balls and radiating clusters. Probably the more common one is white pectolite, which is sometimes found in complete spheres. The spheres are smooth on the surface, and if they are broken or incompletely formed, the radial pattern of pectolite needles is evident. If you have occasion to handle pectolite, keep in mind that the mineral is the cactus of the mineral world. It will stick you with microscopic needles that are nasty and painful.

Complete to partially complete balls of pectolite used to come from the trap quarries of New Jersey around Paterson. These quarries in basaltic flows are closed and not producing. But take heart, as the basalt quarries around Poona, India, are in full production. Though pectolite is not one of the more common minerals from India, enough of the material comes out that reasonably priced specimens can be had.

A second zeolite that usually forms in radiating needles and spheres is mesolite. Like pectolite, it is found in mammillary form.

Associated with pectolite and other zeolite minerals is the nonzeolite prehnite. Commonly found in the same environment as zeolites, prehnite is usually a lovely pale green, though in rare cases it can be yellow, white, or pale blue. Of interest here is that it most often forms in nice, undulating, hand-size or larger specimens. The surface is usually quite rough, evidence of crystal terminations. This usually gives prehnite a showy luster. Again, the New Jersey quarries were the major source of this mineral in the United States for decades, but that is no longer true. The quarries in India have come to the collector's rescue and are providing nice botryoidal groups of this pretty green mineral.

While hematite, an iron oxide, is the leading botryoidal iron mineral, don't rule out goethite. This brown hydrous iron oxide is frequently seen in botryoidal to mammillary masses. The surface of the mineral can be slightly reddish, but it is generally brown and banded in shades of brown, sometimes shading into a nice yellow. Goethite is often found in iron oxide deposits, for example, in Michigan and at Cerro de Mercado in Durango, Mexico. Like so many massive minerals in this grouping, unless the mineral has fine color like smithsonite, hemimorphite, and the colorful quartzes, little attention is paid to saving specimens. But the collector should be aware of such minerals because they are seldom expensive and can become an integral part of any display when you obtain a good display piece.

Both pyrite and marcasite can add a lovely brassy color to a display of minerals in this group. While both form mainly in discrete crystals, they are also found as rounded, grapelike masses. The metal mines of the Viburnum Trend in Central Missouri produced some lovely botryoidal pyrites and marcasites. The mines of Cornwall, England, were particularly productive of such specimens, as was the classic copper deposit at Bristol, Connecticut. In the Cornish mines, the pyrite was often multicolored and lumpy, so the Cornish miners gave it the name goose dung ore!

There are many more minerals, such as calcite, aragonite, chalcanthite, gypsum, and opal, that form in undulating masses showing a botryoidal, mammillary or reniform surface. While these are fun to add to a collection, the biggest difficulty is finding specimens like this for sale, since they are not as appealing to the general collector. But in many cases, they sell for less money than crystallized specimens of the same species, so a collector can assemble a small and attractive suite of such minerals and still be able to afford fine crystal specimens, as well.

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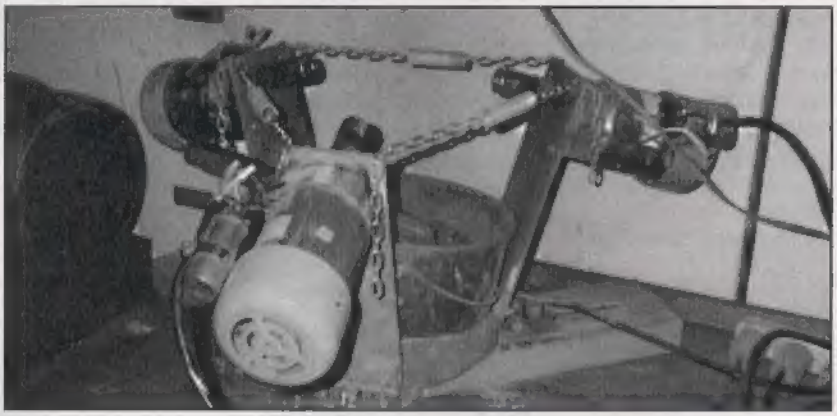


I received an e-mail from Jay Bates a while ago saying that he read with interest the column on Paul Broste's sphere machine (March 2004 *Rock & Gem*). It seems that Jay is a sphere maker and a builder of sphere machines. He sent me a Web address at which I could see pictures of his and others' machines. This was where the fun began.

I went to the Web site, but what I found was a lot of pretty rectangles where the pictures should have been. Each rectangle had that annoying little red X in the upper left-hand corner. My first assumption was that the site was having a problem, since this is often the case. After a few more tries over the next day or so, my poor old brain kicked in briefly, as it sometimes does, and I read a little further to discover that one must be a member of the Yahoo Sphere Makers and Collectors Group in order to view the online pictures.

Well, my interest was redoubled. I really wanted to see these pictures now, so I decided that I would have to join the group. There is no charge to belong. All I had to do was fill in a small form and wait for my membership request to be OKed. When this was all done, I finally got to look at the pictures—and it was well worth the effort. If any of you have an interest in spheres and/or sphere making, you really should join this group. There are postings with pictures of all aspects of the hobby, including homemade machines and parts. Members also post hints and tips and generally discuss everything you might want to know about these fascinating round beauties.

The photo at the head of the column this month is of one of Jay's machines. This one is a three-head machine that he built on a steel base. The motors began their life as parts of a Xerox machine. Jay found them at a site on the Internet. He added capacitors to each motor and used a power strip, so that each motor could be plugged in separately. The power strip, of course, has a circuit breaker built in to shut things down in case of a short.

Jay also built a similar three-head machine with a wooden base, and has modified a two-head machine. It was originally built by a man in Los Altos, California, who had it set up to grind 2 ½-inch spheres, but after Jay's modifications, it can now grind up to 6-inch spheres. He keeps the grit flowing to his machines through a homemade grit feeder made from a body lotion bottle, a 1 rpm geared toy motor, and a wooden dowel. The dowel is sharpened in a pencil sharpener and attached to the motor shaft with a small piece of rubber tubing. The sharpened end of the dowel is inserted in a hole in the bottle cap and, as the motor turns, meters grit to the sphere. Water is supplied by a medical catheter drip system.

Just to show that he is not entirely taken up with sphere making, Jay sent along a picture of a tumbler he made using ½-inch shafts and brass bushings.

If you would like to join the sphere group, just go to http://groups.yahoo.com/group/spheres and sign up.

Please feel free to contact me if you have a suggestion or comment about this or any of my Shop Talk columns. My e-mail is quappelle@cox.net, or write to me at 25231 Pericia Dr., Mission Viejo, CA 92691.

FIELD TRIP

A New Start for the RAY MICA MINE

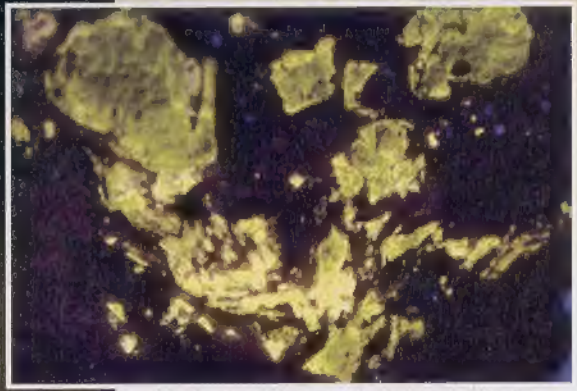
Water Rejuvenates a Long-Time Collecting Site

Story and Photos by Richard J. Jacquot

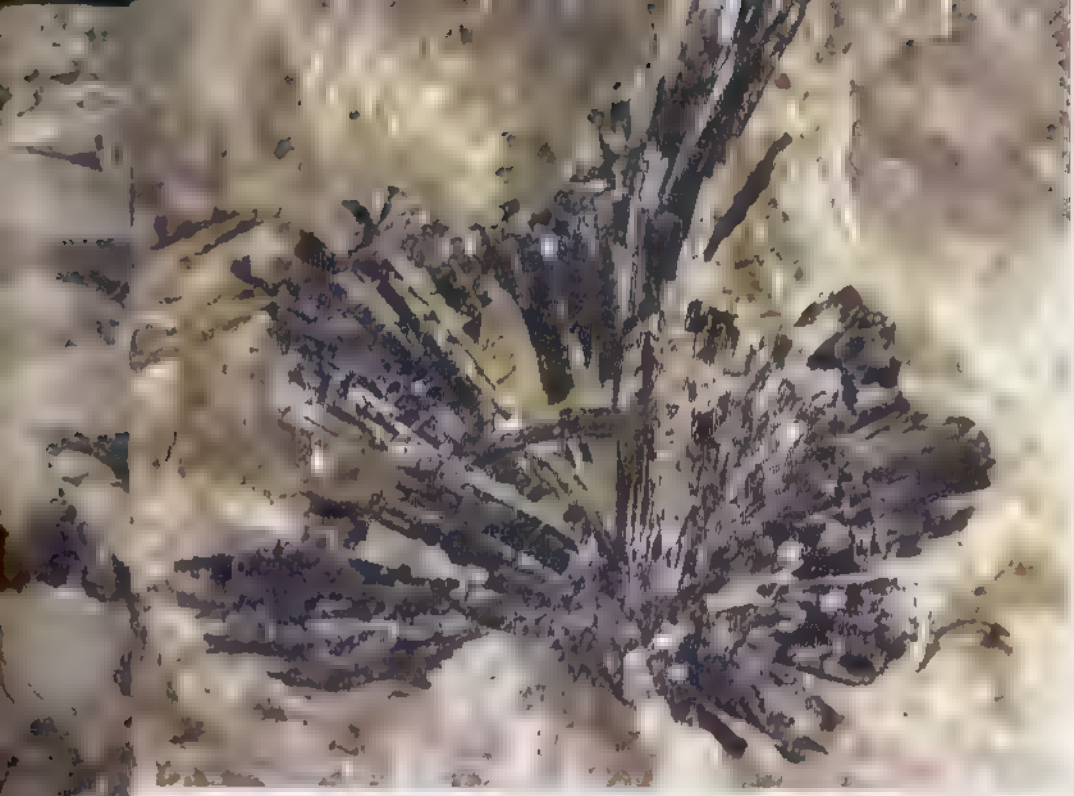
The Ray Mine is a pegmatite mine located on Hurricane Mountain in the Pisgah National Forest, southeast of Burnsville, North Carolina. The mine is actually a series of open pits and vertical shafts throughout the pegmatite area. The Ray is a granitic pegmatite in the Ashe Metamorphic Suite. Charles Lesure described it as a muscovite-perthite-quartz-plagioclase pegmatite in "Mineralogy and History of the Ray Mica Mine," by J. William Miller and Curtis W. Allen (North Carolina Geological Survey Geonote 8, p. 4). In the same article, Carl Merschat said the association of beryl, autunite, apatite, and thulite is common to the Spruce Pine pegmatite group, and suggests that the Ray may be related to that group (p. 4).

The Ray Mine was worked for mica and feldspar for over 75 years. Prospecting was begun by Thomas Clingman of Asheville, North Carolina, in 1867. The mine was operated off and on from 1868 through 1944. The mine derived its name from Garret D. Ray, who operated the mine from 1868-85. In 1944, the Ray was owned and operated by the Asheville Mica Co., but proved unprofitable, and was eventually closed.

This 4-inch by 1-inch double-terminated beryl crystal, one of the first I found at the mine after the flood, is now on display in the Henderson County Mineral & Lapidary Museum.



Plenty of apatite is now to be found at the Ray Mine. It fluoresces a bright yellow-orange under short-wave UV.



▲ Black tourmaline or schorl, is a common find at the Ray Mine.

After the flood, there was plenty of nice moonstone to be had. ▶

◀ By walking the creek bed, you will find a lot of smaller beryl crystals, some of them facet grade.

The land the mine occupied later became part of the Pisgah National Forest. Soon afterwards, local rockhounds began to descend on the site in search of, not mica or feldspar, but the byproducts the mine produced. Of interest to collectors were beryl crystals, aquamarine, tourmaline (schorl), garnet, amazonite, moonstone, and more. For the past 60 years, many beautiful cabinet specimens have been removed from the mine dumps by locals and visiting rockhounds from all over the country. As the years passed, the Ray became a famous location for collectors from all over the world.

The dump material from the Ray runs deep, 10 to 30 feet in places. Most collectors visiting the area are in search of the quality beryl specimens to be found, but after 60 years of collecting, beryl was getting scarce and much work was required to find a decent piece. In 1998, a local geologist, Dr. William Miller of the University of North Carolina, Asheville (UNCA), and one of his students, mineralogist Curtis Allen, began a new study of the Ray mica mine. The purpose was to update the older outdated reports and to document previously undiscovered mineral species from the site.

After two long years of research, the results were published as "Mineralogy and History of the Ray Mica Mine, Yancey County, North Carolina" (N.C. Geological Survey Note 8). You can order a copy of this paper by writing to North Carolina Geological Survey, 1612 Mail Service Center, Raleigh, N.C. 27699 or by visiting the Web site www.geology.enr.state.nc.us. In their paper, Miller and Allen introduced many new and interesting minerals to collectors. Soon, many rockhounds — myself included — began to hunt for other minerals in the absence of the beryl specimens.

One of the minerals documented and analyzed by Miller and Allen is a variety of green tourmaline, variety elbaite. These tourmalines occur in the older mine workings near the top of the ridge. I collected many beautiful specimens as sunburst-type sprays of the elbaite tourmaline on mica. I also collected many nice pieces of apatite, ferrocolumbite, almandine garnet, schorl, and amazonite. The apatite at the Ray usually occurs as large, fractured crystals or in massive form, typically a pale green to violet color. This apatite is highly fluorescent and will glow a bright yellow-orange when exposed to short-wave ultraviolet light.

continued on next page

It had been rockhounding as usual at the Ray until the spring of 2003, when the Forest Service decided to close the access road to the mine. They cited siltation of the creek in the area and unauthorized motor vehicle use on forest land among other things, as their justification. Rangers also began advising visiting rockhounds that any activity other than surface collecting would result in a fine. This was when our club, the Mountain Area Gem & Mineral Association (MAGMA) went into action. Our field trip club was formed in 2000 and is dedicated to preserving collecting sites in North Carolina and the southeast. (Visit www.wnerocks.com for more information.) After a series of meetings and negotiations with the Forest Service, the mine was reopened to collecting and things went back to normal. The rockhounds were happy and things went undisturbed for many months. The Forest Service even built a nice trail for us 'hounds to hike to and from the mine. My club and I visited the mine regularly.

Our first field trip to the Ray Mine after the flood was attended by 30 members, and everyone left with nice specimens.

THE POWER OF WATER

It was September 2004. I usually set up the field trips for the club, and we had not visited the Ray Mine since winter 2003. I decided to plan our first fall/winter trip to the mine. Hurricanes Fran, Ivan and Jeanne had bombarded the East Coast during the beginning of the month. While the southern states, especially Florida, took the full impact of these monsters, North Carolina received an unseasonable amount of rain. This resulted in massive flooding in the mountains of Western North Carolina.

Having rockhounded these mountains for 15 years, I knew one should always visit the old mine dumps after a good rain to see what had washed up. After watching the news and seeing the damage caused in the vicinity of the Ray Mine (the Burnsville/Spruce Pine area), I had to make a trip out there to assess the damage firsthand and see if our club would be able to access the mine for our upcoming trip.

On a Friday morning, my friend John Deney and I headed for Burnsville. It was an awesome sight to see the destruction caused by the floods. The main road (Bolens Creek Road) to the mine was gone! It had washed into Bolens Creek about a mile from the mine site. I found some back roads that, after a 10-mile detour, brought us to the site. As we began the half-mile hike to the mine, the first thing I noticed was the huge rocks that had washed into the road. 60- to 80-pound boulders had been deposited in the roadway 30 to 50 yards from the creek. That's when I started to realize just how tremendous the flood had been, but it wasn't until I reached the creek running through the mine dumps that I understood the full impact of what took place.

At the spot where I usually crossed the creek at the beginning of the dump piles, there was now a 5-foot drop-off. What used to be a small, trickling stream meandering through the dumps was now a roaring river! There were waterfalls 6 to 8 feet high where none had previously existed. As we made our way upstream, I observed the deep cuts into the banks caused by the flooding. Dump material that had been buried 5 to 15 feet deep for decades was now exposed. What would normally take days to uncover by digging was now part of the new landscape of the mine.

After taking some photos of the area, we decided to search the creek to see what had washed up. Two minutes later, I had found a 2-inch by 2-inch stubby, pale-green beryl crystal. It was perched on top of a large rock in the middle of the creek, almost as if someone had placed it there and forgotten it. A few minutes later, I observed the classic hex pattern of a beryl crystal in a mudslide next to the creek bank. What I pulled out was a 4-inch by 1-inch perfect, doubly terminated green beryl.

This was heaven! I was finding more beryl in a couple of hours than I had in the last couple of years at the mine. This continued into the afternoon; every few minutes, John or I would shout with glee, like two small children in a candy store, as we found another crystal. By the end of the day, I had 85 pounds of beryl crystals, beryl in matrix, and apatite crystals to haul down the mountain. I don't think we quit grinning for hours. Needless to say, the club trip was a go!

I emailed our members and showed them pictures of what we had found. The result was the largest club field trip we had ever had. 30 members met at the entrance of the trail leading to the mine. As we gathered our tools and prepared for the hike up the mountain, Bassey Bennet came out to see what was going on. Bassey lives in the last house on Ray Mine Road, next to the trail head. As a young man, Bassey had worked in the Ray mines when they were commercially active. I have talked with him on many occasions and have learned much about the mine from him. In the past, he had told me stories of discovering beryl crystals a foot long and 6 inches across. Unfortunately, Bassey is too old to make the hike up the mountain to the mine anymore, but we always make sure we stop on the way out to show him what we found. Bassey is one of the last old-time miners and rockhounds in the area.

Once we reached the mine area, the club members dispersed to different locations along the half-mile stretch of creek. I picked a spot and began searching through the massive piles of washed-up feldspar and quartz boulders. Every few minutes, I would hear someone yell when he had discovered another nice crystal. About lunchtime, one of our members came downstream to where I was collecting. He said he had been looking around far upstream where the mine dumps ended when he noticed a small bear cub walking through the woods. He then noticed the bear cub's mother charging down the hill toward him. Needless to say, he searched the lower end of the creek the rest of the day!

Everyone in our club left with many nice specimens that day. Beryl, instead of being the elusive gem, was abundant once again. That evening, after most of our club members had gone, a couple of members stayed around until dark

John Deney shows off the large beryl crystal in matrix he collected from the creek bank.

Later, they told me a young man had come to the mine just before dark, and within a few minutes pulled a 6-inch blue aquamarine crystal out of the creek bank just above where I had been collecting. Normally, I would have been kicking myself for not finding the piece while I was there, but then I looked at my kitchen counter and stovetop covered with beryl crystals, and all I could do was grin.

In fact, I'm still grinning. Two of the best crystals I recovered, a 3-inch by 3-inch doubly terminated green beryl in matrix and the 4-inch by 1-inch crystal I found the first day are now both on display in the Henderson County Mineral and Lapidary Museum in Hendersonville, North Carolina. The power of water can be an awesome thing, and this flood has given the Ray Mine a new beginning for collectors. I estimate there will be many new finds made over the next few years.

TO GET THERE

From Asheville, North Carolina, take Interstate 26 west to Exit 9, the Burnsville/Spruce Pine exit. Turn right toward Burnsville on U.S. Highway 19 North and travel .7 miles into Burnsville. Turn right onto state Route 197 South (Pensacola Road) and travel 0.7 miles to Bolens Creek Road. Turn left and travel 3 miles to Ray Mine Road. Turn left and follow Ray Mine Road to the dead end at the U.S. Forest Service trail. Before heading up to the mine, stop in and say "hi" to Bassey, he loves to talk rocks and tell stories about the mine. Then follow the trail approximately 0.3 mile to the mine dumps.

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LAPIDARY LORE AND MORE

by June Culp Zeitner

My Shell Game

In 1951, Albert and I were spending our winter in a luxury trailer park in Florida. Next to us was a large trailer with a so called Florida room built on in front. We spent our time digging agatized coral.

One day when we came back with quite a few good coral geodes, Arleen, our neighbor, came over and asked what we were washing off with our hose. We said, "Agatized coral geodes."

"Ugly things," she observed. I agreed, and then showed her some we had cut and polished the year before, also some jewelry.

It was love at first sight. After the "oohs and aahs" she said, "I'm a shell collector. If I teach you how to get a fine shell collection, could you show me how to collect gems and minerals?"

I couldn't say "yes" fast enough because part of the winter agenda was to find or buy a shell collection for our family museum.

We took her to Tampa Bay the next day. I never saw anyone find more pleasure digging in the muck. She was ecstatic over the geodes she found.

A few days later, there was a storm. Arleen observed that the tide was low after the storm and stated the conditions were right for successful shelling. We went to a beach south of Fort Myers. Albert and I started picking up pretty shells that were lightly bleached and had only minor damage.

Arleen told us museums and collectors used only shells that had been taken live or had only recently expired. She picked up a brigat univalve, which I thought was perfect, and told me it would be unacceptable by an experienced collector. "See," she explained, "the operculum is missing. It's the door, a part of the shell."

Arleen noticed a siphon reaching a bit above the sand. She reached down almost to her elbow and brought up an attractive bivalve with the remark, "Some species burrow."

I couldn't imagine what I'd do with my live specimens. Arleen made it easy. "First, put them in boiling water for a moment, killing them instantly. Then put them in anthills. The ants clean them out to the top." She said, "You can buy a book naming Florida shells. The rarest native shell is Junonia." This pleased me. Eventually, I found my distinctive brown and cream shell, a handsome volute.

"A faster way to get an interesting collection is to go to any place where the shrimp boats dock," said Arleen. "Their nets always have a nice variety, and they sell the shells cheap." I took some of Arleen's advice, but shrimp boats are rare in South Dakota.

I loved the common names of the shells: cone, tulip, lion's paw, olive, pen, venus, bullet, jingle, scallopy trumpet, duck foot, eggshell, trumpet shock turban, envelope, and whizbang.

We went shelling at several Florida sites. The best was Captiva Island. It is now connected to Fort Myers by a bridge, but in those days we had to go by boat. Porpoises always followed us and sometimes led the way.

Soon, I became the teacher. Arleen asked, "A friend gave me a nice white rock. What is it?"

"First," I asked, "is it a rock or a mineral? They are not the same. Second, whichever it is, there are probably several hundred that are sometimes white. To make a sensible guess, if it's a mineral, I'd need to know its crystal system, hardness, density, and scratch color, and it would help to know its associates and location."

"For example, if it was a white mineral, it could have quartz, which occurred in a pegmatite and was accompanied by feldspar, muscovite and schorl."

I gave her a copy of *Mineralogy for Amateurs*, by John S. Arkansas. She was a fast learner, and as attracted by the names of minerals as I was with the shells. She said, "You mean these minerals, without the rare are named, brook, antler, horn, bowl, tenant and magnet?"

She was most interested in gem minerals and asked my favorite. I answered, "Gem chrysocolla, tsavorite, tanzonite, and black opal."

"I thought you'd say diamond or maybe emerald."

"Diamonds are quite common compared to a good emerald or ruby and are fine accent stones," was my reply.

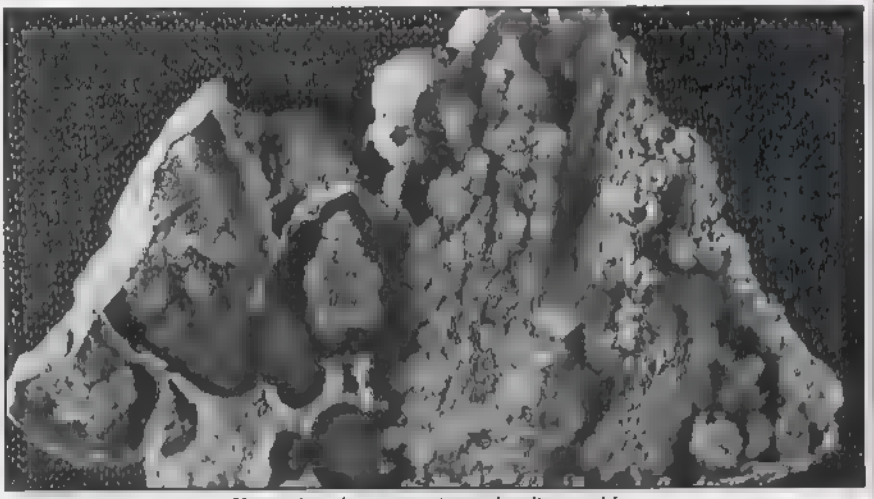
"I wonder," she continued, "why there aren't any precious stones in America."

"There are emeralds and rubies in North Carolina, sapphires in Montana and diamonds in Arkansas and on the Colorado-Wyoming border. Canadian mines are productive. Many gems are far more rare, and to me, more beautiful."

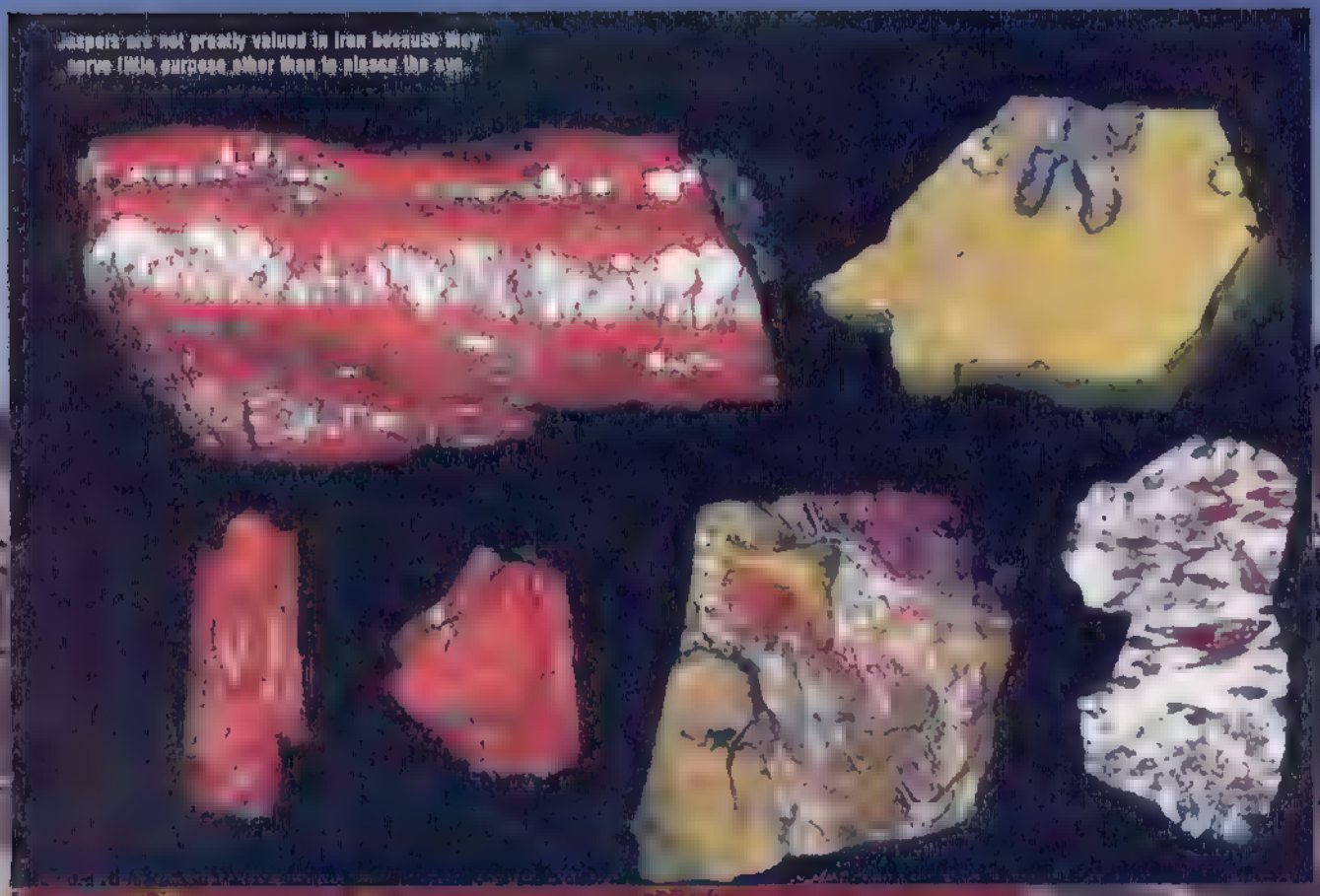
Arleen's lessons continued, as did mine. I continued buying shells if I saw rare ones at moderate prices, but the best shells I have are those we found on Captiva after a hurricane.

What about Arleen? She took the GIA colored gem course, passed the jewelry course, made collecting trips to North Carolina yearly, and then taught gem and jewelry courses and started a gem club. She was known as "The Rockhound Lady," but then, so was I.

The next time I saw Arleen, I presented her with an agatized cone shell from Tampa, saying, "Arleen, from the very first exchange of information, we haven't been far apart. Our interests were both associated with the mineral kingdom." ☆



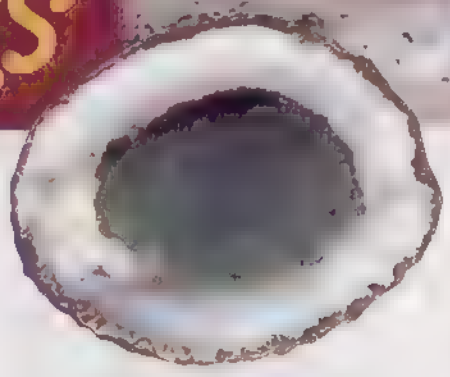
Many minerals are pseudomorphs after sea life.



Trading Rocks

The Internet Fosters a Rewarding Relationship

Story by Esther C. Lively / Photos by Maziar Nazari



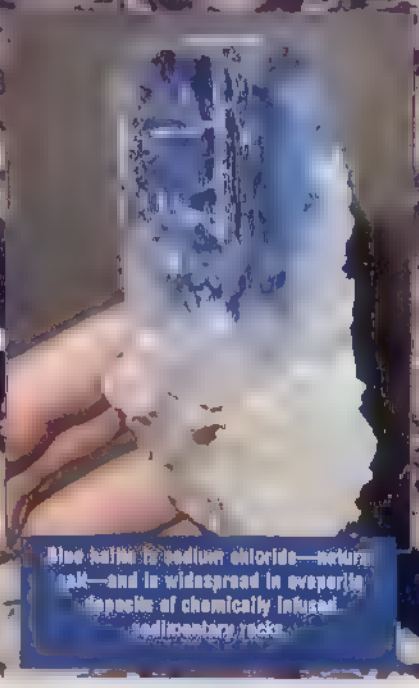
Pure white chalcedony holds clusters of gemmy quartz crystals in this 6-inch nodule from the Khur agate fields.

Little did I suspect while watching my children install the old computer on my desk, that within two months I would be "in" Iran talking with college professor Maziar Nazari about Iranian minerals. Summer rock hunting was on hold because of forest fires raging throughout most of Oregon's backcountry when I sat down for the first time to learn more about my new (used) computer. Grasping the handwritten list of instructions that my son had left in hopes of teaching me how to search the Internet for rockhounding Web sites, I suddenly found myself in the Iranian desert looking at a smiling young Persian named Maziar Nazari, who waved casually at the camera.

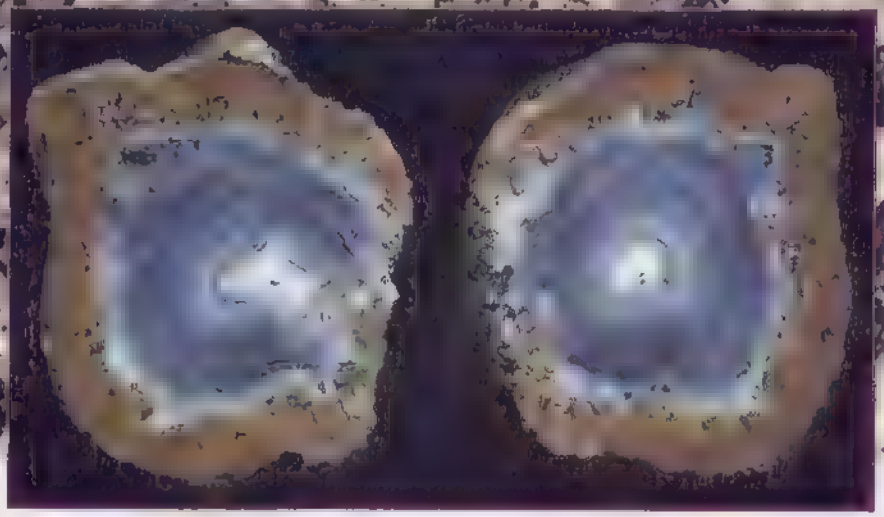
I stared at the monitor. Land stretched openly into the distance behind him. Not just flat desert, but land with contours. Until that moment, the name Iran had conjured up mental images of empty desert sands and arid dunes. Instead, I found myself looking at deserts like our own, with multiple geological formations shaping the landscape.

Iran is a very large country and the terrain ranges from remote mountain ranges to arid desert sands very similar to the ones depicted by Hollywood. Massive mountains lift out of the desert floor into peaks that rival those found in any American mountain range, with rivers flowing through valleys fed by condensation and rainfall. Ice even forms in higher areas during winter, sustaining native life in many forms. Occasionally, volcanic events occur. When fault lines or crustal plates deep beneath the earth's surface shift, massive eruptions thrust subter-

Epithermal veins developed this combination of orpiment and fluorite found in the Zarch Shouran Mine.



Blue halite is sodium chloride—natural salt—and is widespread in evaporite deposits of chemically infused sedimentary rock.



Influenced by silicate of sodium, calcium and aluminum, rich blue colors the agates found in the Ramin area.

ranean matter upward with explosive force, causing lava flows and vents, just as they do here in the Western Cascade Mountain Range and other places around the world.

One area, approximately 50 miles from Hammadan City, is known for Iran's largest cave system, called Ali-Sadr. It takes four hours to walk through its main chambers. Caves abound in this area and in other locations. Iranian minerals are varied and many. Often named after the locality where they are found, highly desirable minerals such as scelite, knademite, antarakite, variete, wulfenite, smithsonite, cerussite, hemimorphite, agate, and jasper abound in the Iranian countryside. Persian turquoise has been revered by royalty throughout the world for over 3,000 years because of its purity, density, and rich blue color. Most rare of all, telemessite and iramite are found only in Iran, and even there, they are seldom seen, though Maziar claims to know of one accessible location that he plans to visit soon to bring back samples.

On my computer screen, I saw silicas, crystals, pegmatites, ores, and schists, and a select on of cut and polished thunder egg halves so beautiful that I wanted to reach out and touch them. They all bore familiar-sounding names, though many of them I'd never seen before. After staring at the screen for what seemed like hours, I finally entered the Web site's guest book and wrote a small note informing Maziar that my husband, Jim, and I were long-term members of our local Mount Hood Rock Club. I thanked him for the opportunity of viewing his Web site, typed in my e-mail address, and then signed off. My dreams were flooded with beautiful swirls of colorful, exotic agate.

The next day, I found a letter in my e-box that marked the beginning of a richly rewarding friendship. Maziar speaks fluent English as well as Farsi, his native Persian tongue and the common local language of Iran, Tajikistan, and some parts of Afghanistan. After receiving his bachelor's degree in General Geology from Tabriz University, he went on to gain his master's in Ore Geology from Teachers' Training University in Tehran in 1994. Since then, he has been teaching full courses in Geological Science and Mineralogy at the University of Ashtiyan in Tehran. In the near future, he hopes to obtain a grant from a good university in the United States, Canada, Australia, or New Zealand in order to complete his desired doctorate in Ore Geology.

Quietly soft spoken, yet with a commanding presence, Maziar battles the daily problems of teaching young Iranian students a very demanding subject using courses that he primarily developed himself, courses far in advance of the methods previously used. Through integrity and a desire to make the future better for the young people he teaches, Maziar has combined specialized knowledge, technique, and skill with endless hours of extracurricular work on his own time. Recently promoted to head of the scientific department at the university, Maziar, 36, is now responsible for a staff of 12 other teachers and approximately 400 students. Each of his classes averages around 30 young people. During the past summer, Maziar spent many hours of his own time upgrading and redesigning much of the material on the university's computer programs that will be used in teaching during the current school year.

continued on next page

Mazlar carefully juggles his limited personal time between home, with his lovely wife, Mojgan, and 6-year-old daughter, Negar, and his second love, working in Exploration Geology. He also works as a consultant for Geological Exploration Companies. Self-taught in the fields of geology and mineralogy, which he now teaches at the University, Mazlar wandered the countryside near his home as a young high school student, carrying his favorite reference books by Dr. John Sinkankas. Filling journal after journal with personal notes and observations, mostly in the form of questions that he would later try to find answers to from his limited sources, he collected many unique specimens that he still values today, often using them for classroom purposes at the college.

Mazlar's mother, who taught at the local high school, encouraged him to write letters to his favorite authors in order to aid his research. Together, they sent for books, which he devoured, always seeming to want and need more knowledge than they contained. Banned from American sources by political issues, Mazlar finally discovered that many of the best American titles were available in the European marketplace. It was permissible to shop in Germany and the United Kingdom, so mail order became his salvation, and over time, Mazlar began to realize the direction his life would take.

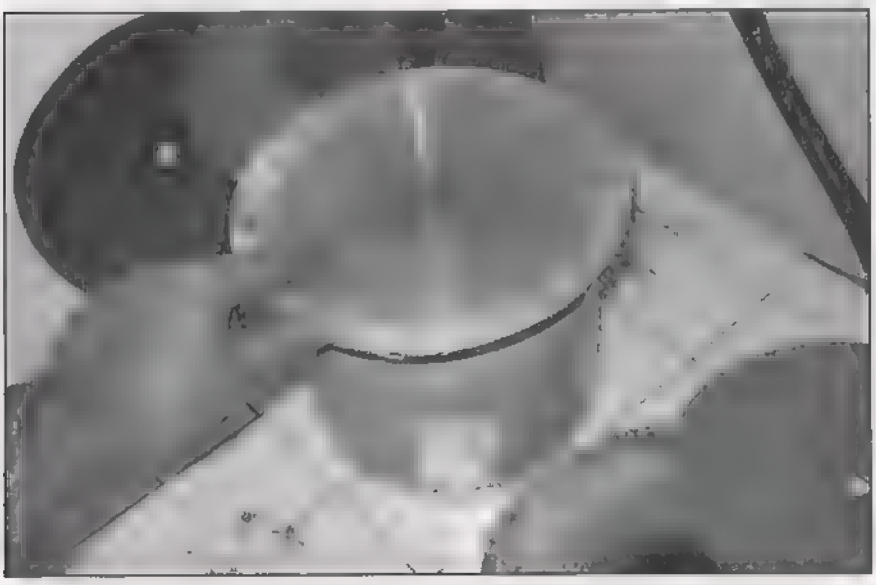
It took only two letters for Mazlar and me to decide that we wanted to trade rocks. Several quick trips to some local rock shops, plus a few late-summer mineral shows, and I had my box of surprises all packed and ready for the post office. That's when I learned that the expensive little piece of blue-bladed kyanite I'd just purchased for him had come from Afghanistan, within driving distance of his home. It was time to discuss this.

I soon learned that he knew much more about rocks than I could ever hope to know. Pictures of field trips taken with his students to collect minerals and ore samples began to accompany his letters back to me. I explained about my own busy preparations for our upcoming Mount Hood Club rock show, promising to send pictures to him with my next package. Mazlar expressed his delight, anticipating the joy of surprising his students with the treasures he would receive from me. He intended to display them at their next rock show.

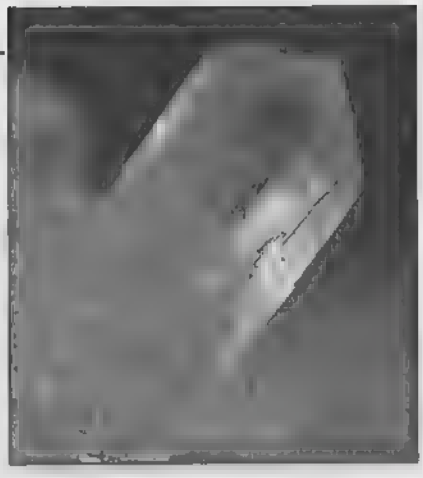
He explained in detail how I should mark my packages so that they would pass through Iranian customs. It was decided that seeing open the Mexican coconut geodes I had purchased (his choice when I finally asked what he would like to have) would let me make sure they were worth the price of the postage. Taping them closed again using several layers of masking tape and packing them individually in bubble wrap would protect the interiors from damage, but they could easily be inspected by Iranian customs officials.

It is not permissible to send finished jewelry items or polished gemstones of any kind from the United States into Iran. Resale is forbidden, and American money is not allowed into the country in any form. Many things came to light, as Mazlar and I shared our packaging tips. I could not purchase things from him, but we could trade.

Finally, assured that my gifts were worth sending and would truly please him,



Mazlar's failed attempt at making his own faceting machine became a useful cabbing tool.



Colemanite is a low-temperature mineral and usually occurs in evaporite deposits of chemically infused sedimentary rocks

I stood in front of the counter at our local postal outlet. My knees nearly went out from under me when the clerk told me how much it would cost to ship the box. Worse, my packages could not be insured.

"Claims tickets must be correctly filled out and attached to the outside of each package," the woman told me. "They must include a reasonable estimate of the total value of the items inside."

As she turned away to select the proper forms, a gentleman standing behind me in line, whom I knew slightly, leaned forward and quietly suggested that I use a figure of under $100 regardless of the true cost of the items inside.

"Anything valued over $100 will be opened for inspection at several possible checkpoints as soon as it leaves the United States," he said. "Anyone who has access to the package when it leaves the United States also has the right to reject or confiscate whatever they choose. Declaring a lower amount on your claims ticket will reduce the risk of temptation a little. Rocks should be a pretty safe bet, as they have no value at all." He winked.

The postmistress returned with the claims forms and showed me how to fill them out. Without batting an eye, I wrote down $50 and handed the form back to her. Apparently, she didn't think rocks held much value either, but mentioned that it was very nice of me to send them to the college. Large signs stating "For Geological Research Only" were boldly posted on each side of my packages, just as Mazlar had instructed. Sighing, I handed over my check. Was this a good idea after all? I had to ask myself. The price felt like hostage money to my budget.

Later that same evening, the Channel 2 news announced President Bush's intentions to seek out Saddam Hussein and his henchmen. A map of the Middle East highlighting a specific area of Iraq flashed onto the screen. My heart leaped, and

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then nearly sank through the floor. Almost at the tip of the erratically moving pointer, I saw the word Tehran barely offset from the Iraqi border. Would my newfound friend and his family be in danger? Would my package be allowed through customs? Would it even arrive? I headed for the computer.

Mazhar assured me that he and his family would be fine. We both prayed for peace and said good night. Days became weeks. Mazhar's letters were apologetic because he'd spent many nights staying at the university, trying to relieve his students' tears and help shield them emotionally from the unrest that had begun to overlap into the classroom.

Mazhar mailed his box to me. I was too busy to spend much time anticipating what could possibly be in it, as our club rock show and some family birthdays, my own included, were closing in, and my package still had not arrived at the university. It had been seven weeks since I mailed it. Hope dies hard, but I had pretty much given up.

Dreary February rain was threatening to turn back into snow when the half-frozen UPS man handed me a battered brown bundle and asked me to sign for it. It was the day before my birthday. Quickly I cut away the wrappings and experienced a joy that can never be expressed. The scent of the oil that Mazhar had used to coat the precious blue thunder egg halves permeated the box with a soft, sweet, rather cream smell like that of sandalwood. The color of lapis lazuli shone in my hands. A finely crafted jewelry box made by a local artisan, a silk tube cover, two couch pillowcases, and candles made from a native plant that grows wild in the area accompanied a precious collection of exquisite specimens.

There was variscite so pure in color it was hard to take my eyes away from it, from a field trip with his students to the Kooshk Zinc and Lead Mine; exquisite Persian turquoise from Nishabour in northeastern Iran; sky blue bladed kyanite crystals in milky quartz, much larger and far more beautiful than the tiny specimen I'd purchased for him and never sent; from another field trip to the western mountainside district called Hamm, dan, which lies 400 kilometers west of Tehran, along with specimens of fibrolite-type sillimanite, andalusite, and several fascinating crystals of enstatite with graphite crosses included down the center length of each one. When cut straight across the crystal's growth, each cut end reveals a perfect graphite cross at the center. The crystalline matrix is pink andalusite.

In addition, there was an astonishingly lovely specimen of epidote plus another of siderite from the Shams Abad Iron Mine in Central Iran, and a unique piece of blue calcite gathered from an old mine site in the Garmsir area, 90 kilometers west of Tehran. Tucked into my jewelry box was a breathtaking 3-inch-long crystal of lavender kunzite (spodumene) from Afghanistan with strong dichroism. With it was a magnificent four-rayed Black Star of India (tensaurite) that Mazhar had obtained and cabbed just for me.

Pictures of field trips Mazhar had taken with his students to collect minerals and ore samples began to accompany his letters back to me.

The next wrapping held a beautifully cabbed moonstone from Sri Lanka that gleamed as if it were lit from inside. Best of all, the last piece of bubble wrap held an exquisite 13 carat citrine that he'd faceted on his homemade 3-lap peg faceter. A hand-written note called it his "Queen" that he had cut for my "American Mom." I wanted to cry. I knew from a previous letter that he recently had traded for them and that he could only afford two pieces of rough at the time he had purchased them.

Mazhar's "little faceting cabbing machine" is his bane and his joy. He wanted to create a way of cutting crystals into gemstones, but there are no rockhounds or hobbyists in Iran, and therefore no machinery or supplies are available for cutting or polishing rock. International mail order costs were simply beyond his means. While reading Sinkankas' book *Gem Cutting: A Lapidary's Manual*, Mazhar began to develop an idea for making a 3-lap peg machine of his own design. Mazhar carefully studied the operation of the rotary system inside an old juicer supplied by his mother. After a couple minor adjustments and a few failed attempts, he drew the final dimensions of what he would need. He then took the design to a turnery, where a machinist friend with a lathe created a perfectly balanced "3-lap." Sandpaper discs would be placed on top of the lap and screwed down with a rounded brass nut. I found to protect both his fingers and the stones in the event they made contact while in use.

Growing certain of success, Mazhar then designed and made a standing 3-lap peg shaft for his new machine. Unhappily, the sandpaper discs rounded the facets on his stones and caused other imperfections. It was a failed dream. There were no other grinding materials available. However, Mazhar's new little machine soon became invaluable to him as a cabbing tool, which he could use for teaching in the classroom. Though he jokes about it now, he still dreams of someday owning a modern American faceting machine. Sometime later, he discovered a pair of Russian-made laps in a vendor's stall at the bazaar. He wrote as he puts it, "Possibly the only cutting laps in the country. While he says, 'They work, though not well,' he considers himself fortunate to have them.

It was nearly a month later when the package I had sent finally arrived in Iran. When the customs officials called Mazhar in to pick it up, they did not make him open the packages in front of them as usual. They accepted my items for what they were, took samples for the college, gifts for the students' research, gifts for the family. These were allowable. I learned later on that because the claims ticket I had filled out declared the value at less than $150 U.S., my young friend did not have to pay customs tax either. That was a great relief to both of us because the fees are very high. Other packages have followed that one, and they will continue to do so as often as I can afford the postage.

Someone once told me that in order to learn another language, one must to learn to think in that language. I've discovered through my own experience that to really learn about the minerals that I collect, I had to get to know someone who lives where they are found.

GOLD AND GEM HIGHWAYS

ROADSIDE PANNING SITES IN CALIFORNIA

Part III: Lassen, Los Angeles, Madera, Marin, and Mariposa Counties

Story and Maps
by David and Cloris Walker

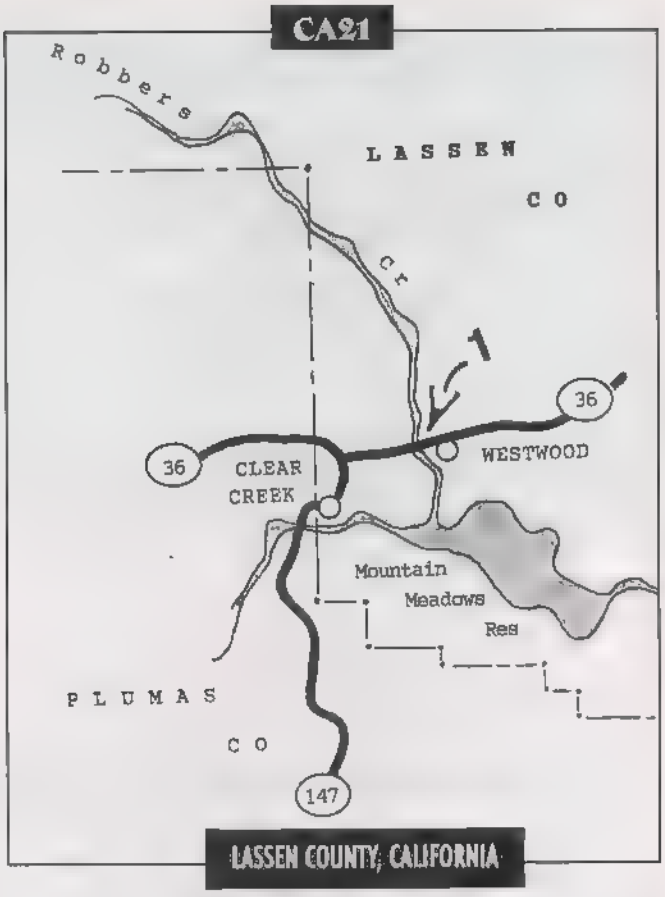
This is the third in a series of 10 articles containing county-by-county maps of suggested panning and screening sites at highway stream crossings where appreciable finds have been previously reported on upstream watersheds. The principles of erosion make it likely that minerals and gemstones have been deposited in river gravels awaiting removal by a rockhound with a pan.

Obviously, a highway-convenience study of this kind is most advantageous for seniors and others who prefer panning under a nice, shaded bridge crossing to tramping over hill and dale. It also eliminates the necessity of locating and getting permission from property owners.

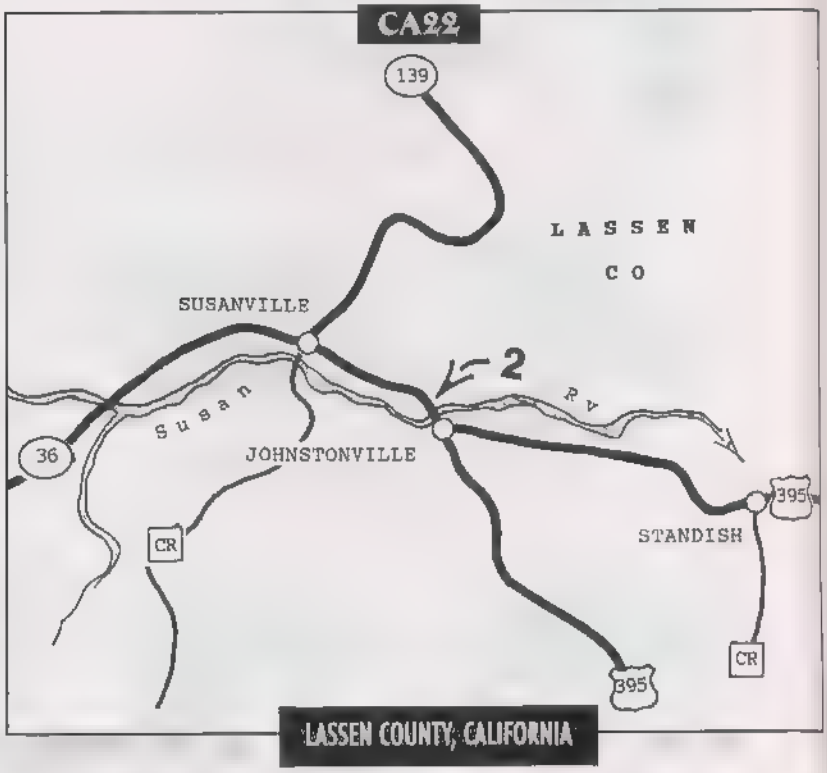
Don't forget, however, that the government to which these rights of way belong has some regulations of its own. Be sure to observe the usual safety and environmental standards if you want to collect without a hassle.

The maps provided contain the most up to date information available to us, but it's advisable to consult a current state highway map when planning an outing, for overall orientation in the field and because highway designations have been known to change.

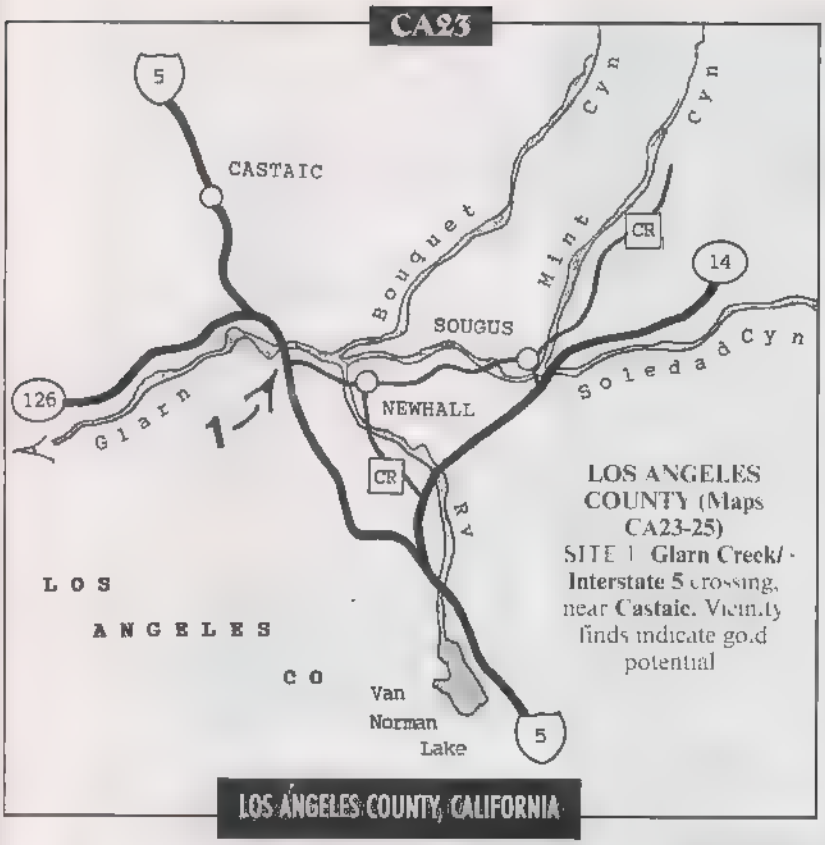
So good luck! While we can't guarantee you'll hit the jackpot, we can almost assure an enjoyable outing.

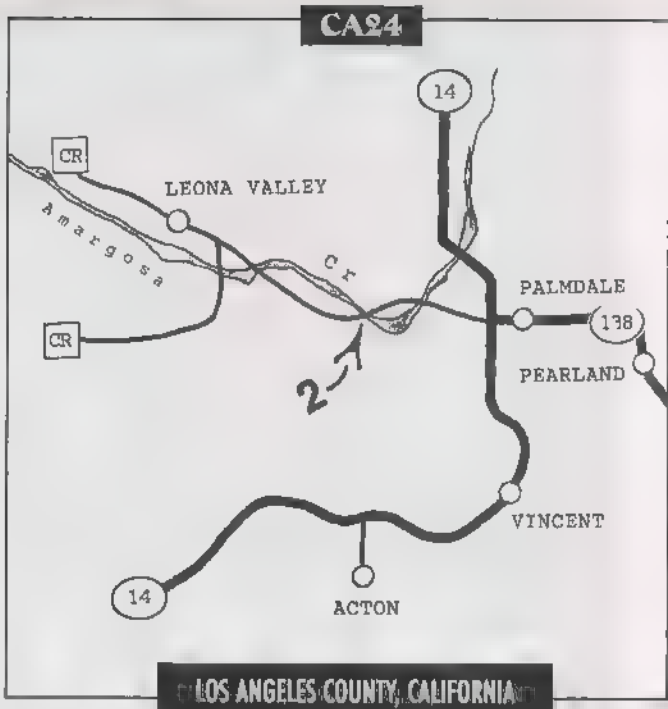


LASSEN COUNTY (Maps CA21-22)
SITE 1 **Robbers Creek/state Route 36** crossing near **Westwood.**
Vicinity finds indicate rhodonite potential.

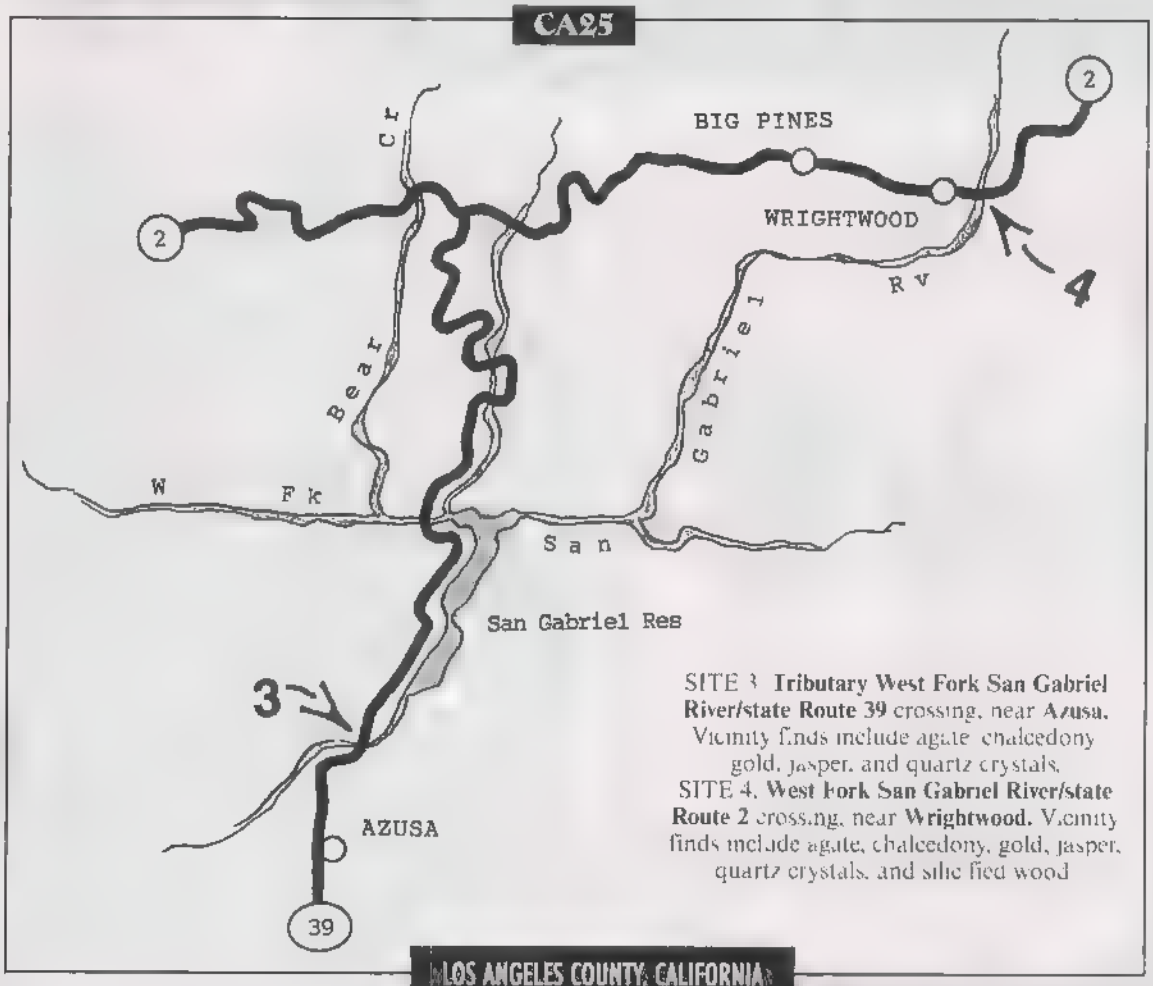


SITE 2 **Susan River/state Route 36** crossing, near **Johnstonville.**
Vicinity finds indicate gold potential.





SITE 2. **Amargosa Creek/County Road** crossing, near **Palmdale.** Vicinity finds indicate rhodonite potential.



SITE 3. **Tributary West Fork San Gabriel River/state Route 39** crossing, near **Azusa.** Vicinity finds include agate, chalcedony, gold, jasper, and quartz crystals.

SITE 4. **West Fork San Gabriel River/state Route 2** crossing, near **Wrightwood.** Vicinity finds include agate, chalcedony, gold, jasper, quartz crystals, and silicified wood.

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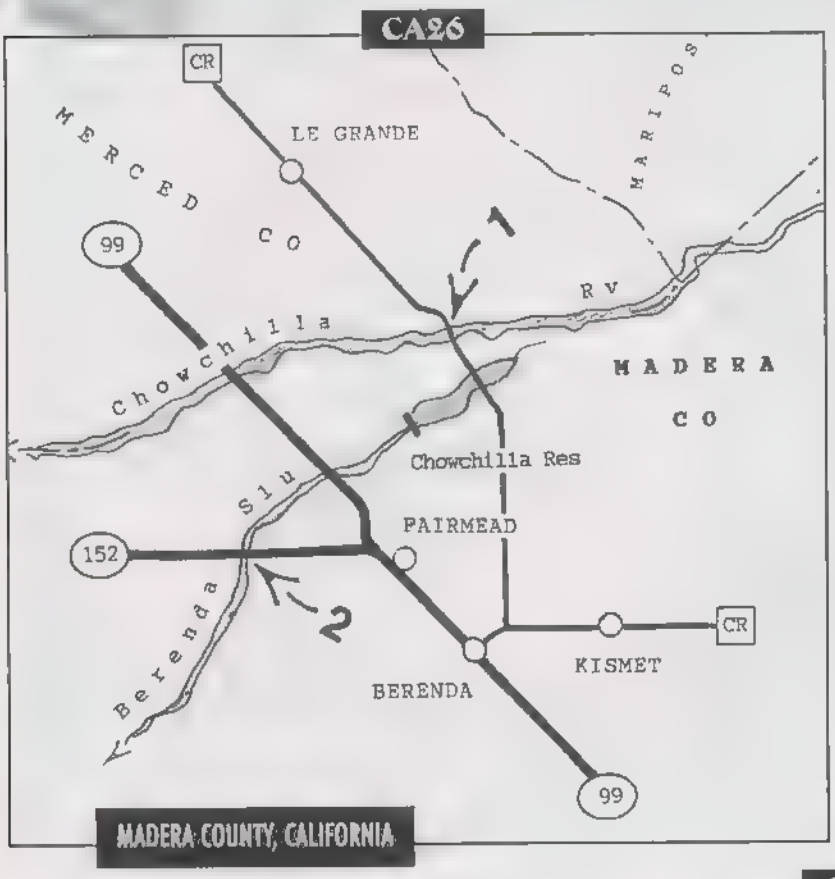
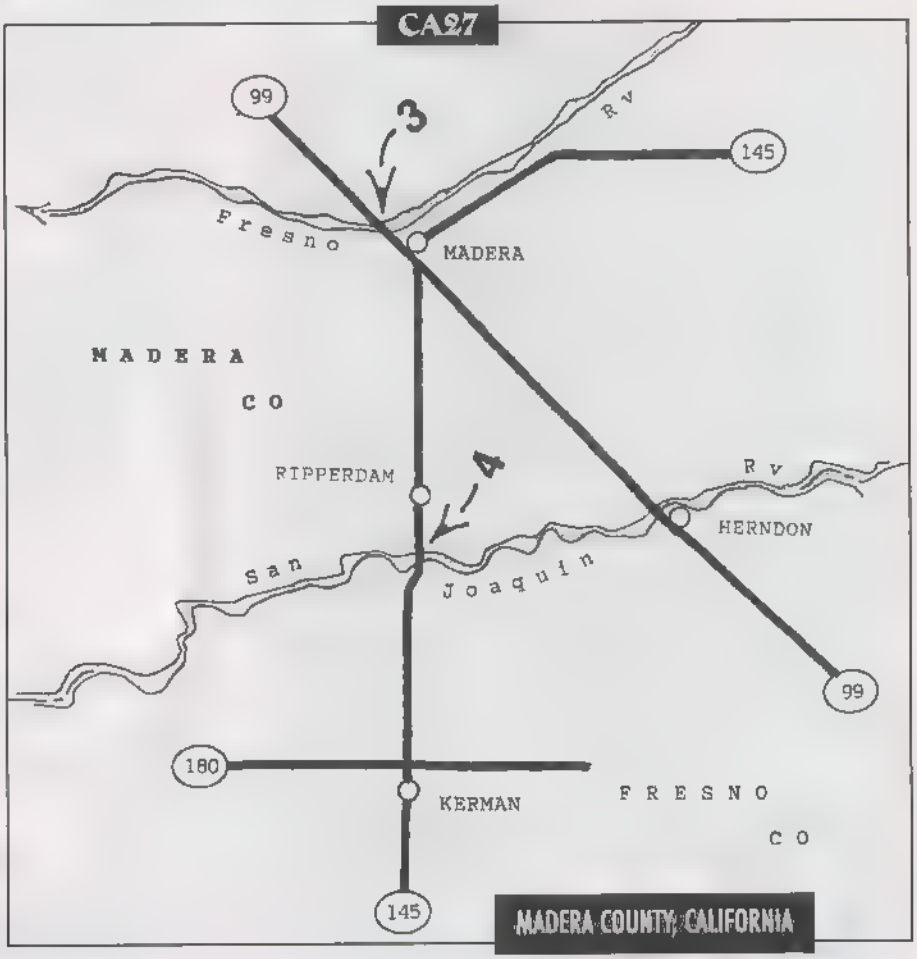
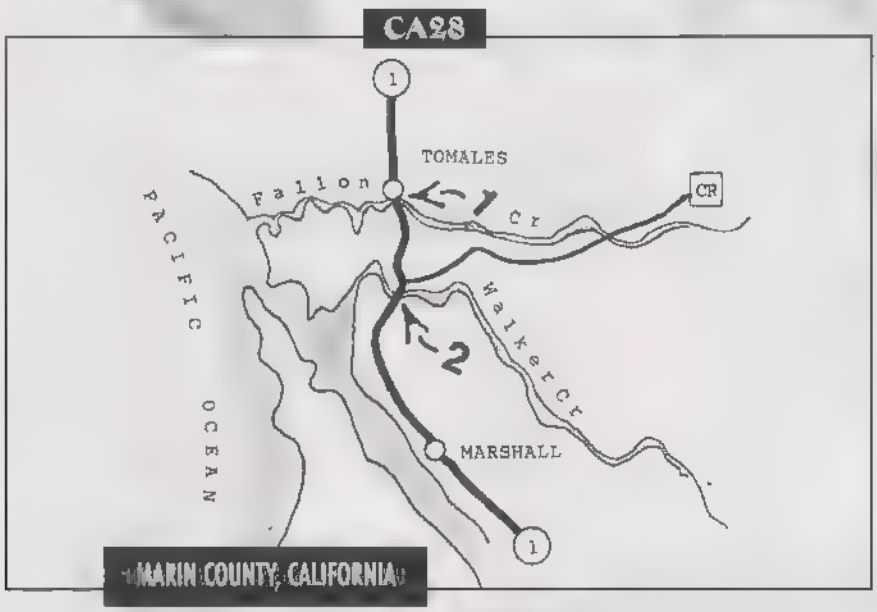


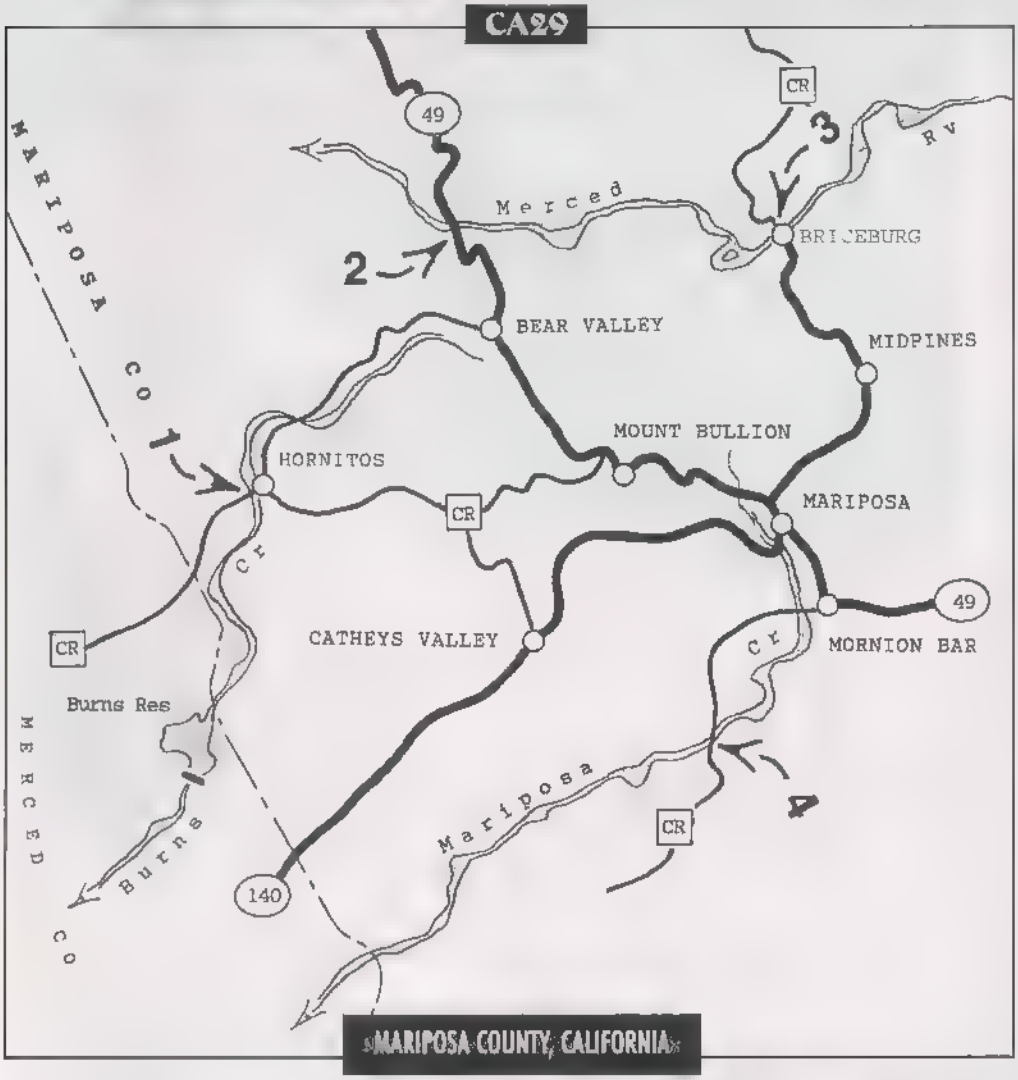
MADERA COUNTY (Maps CA26-27)
SITE 1 **Chowchilla River/County Road** crossing, near **Berenda.** Vicinity finds indicate gold potential.
SITE 2 **Berenda Slough/state Route 152** crossing, near **Fairmead.** Vicinity finds indicate gold potential



SITE 3 **Fresno River/state Route 99** crossing, near **Madera.** Vicinity finds indicate gold potential
SITE 4 **San Joaquin River/state Route 145** crossing, near **Ripperdam.** Vicinity finds indicate gold potential



MARIN COUNTY
(Map CA28)
SITE 1. **Fallon Creek/state Route 1** crossing, near **Tomales.** Vicinity finds indicate jade potential.
SITE 2. **Walker Creek/ state Route 1** crossing, near **Tomales.** Vicinity finds indicate jade potential.



MARIPOSA COUNTY
(Map CA29)
SITE 1. **Burns Creek/County Road** crossing, near **Hornitos.** Vicinity finds indicate gold potential.
SITE 2. **Merced River/state Route 49** crossing, near **Briceburg.** Vicinity finds include agate, chalcedony and gold.
SITE 3. **Merced River/state Highway 140** crossing, near **Briceburg.** Vicinity finds indicate gold potential.
SITE 4. **Mariposa Creek/ County Road** crossing, near **Mornion Bar.** Vicinity finds indicate gold potential.

The official state highway map is suggested in conjunction with these maps for overall orientation in the field.

FIELD TRIP

High Country Fossils

Fossil Fishing in Southwestern Wyoming

Story and Photos by Kenneth H. Rohn

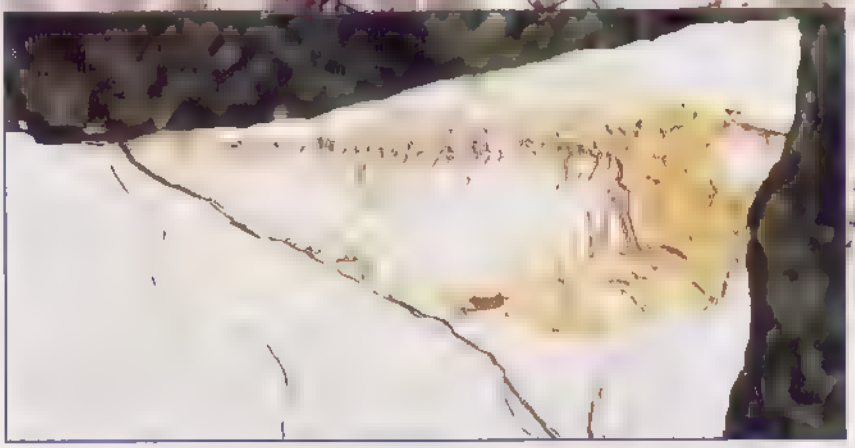
Warfield's manager Glen Frasier points to a productive layer of limestone in the quarry wall

I was driving west on Interstate 80 in southwestern Wyoming. My destination was Kemmerer and points north, where I planned on trying my hand at collecting fossil fish in the Green River Formation. With any luck, and some diligent work, I just might take home the remains of fish that lived here during the Cenozoic Era, some 50-odd million years ago.

When I reached Exit 66 several miles past Green River, I took U.S. Highway 30 northwest to my destination for the day. I spent the night in a motel in town. It felt good to get away from the wheel. As I had been on the road for a good part of the day. It was an ideal summer evening in Kemmerer, and the brilliant red sunset promised that tomorrow would also be a fine day with plenty of sunshine.

Kemmerer, with a population of just over 3,006, is approximately 30 miles east of the Utah border. This is high country, much higher than I'm used to. The elevation is just under 7,000 feet above sea level, better than a mile higher than my home in Minnesota. I had only been in Wyoming for two days, not long enough to become acclimatized to this elevation. I still found myself getting frequently out of breath with even moderate physical exertion.

No trip to this part of Wyoming is complete without a visit to Fossil Butte National Monument. The Visitors Center has impressive displays of fossils fish, animals and plants, and an interesting movie about the geology and past life of Fossil Butte.

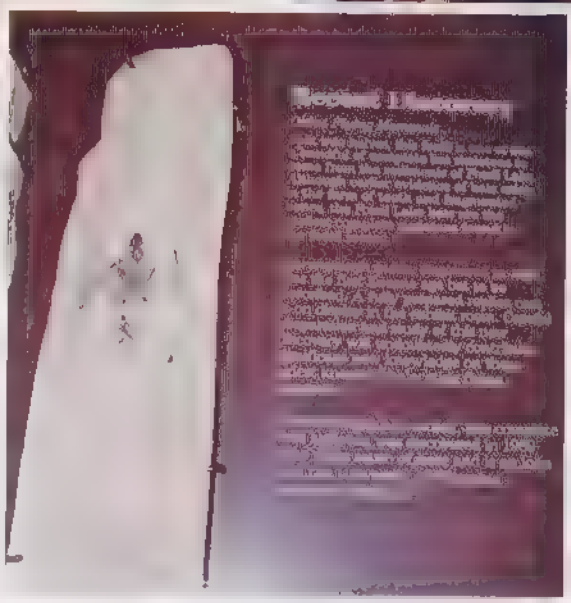


The limestone is rather soft and a bit crumbly, so great care must be taken while splitting it to retrieve the fossils.

Geological evidence tells us that some 50 million years ago, three lakes (Lake Uinta, Lake Gosiute, and Fossil Lake) covered much of this area in Wyoming and parts of Utah and Colorado. Fossil Lake was the smallest of the three. The sediments from this lake, known as the Green River Formation, long ago turned to stone, which contains innumerable fossils. Today, that sediment is composed of layers of mudstone, volcanic ash, and limestone. Strange tropical plants and trees, some long extinct, grew to immense proportions along the shores of this body of water.

This well-preserved knightia appears three-dimensional. The spine is clearly seen

The well-preserved remains of a stingray tail stand out on the surface of this thick limestone slab.



The museum at Fossil Butte National Monument displays area fossils, like this very rare, complete bat skeleton

Some of the vertebrates that lived in and adjacent to this lake were turtles, which often reached a length of 6 feet, and a variety of fishes. The 25 kinds that have been collected here include miopasas, which grew to 18 inches, knightia, a small, minnow-like fish that grew to 8 inches, priscacara, 16 inches, notogoneus, 3 feet, sting rays, 30 inches, diplomystus, 2 feet, phareodus, up to 30 inches, and gars over 5 feet. Species such as paddlefish, gars, bowfins, mooneyes and herring have survived the ages and still live today.

Fossil Lake was immense. It was some 50 miles long and 20 miles wide. It has been assumed, but not actually substantiated, that a part of this lake may have contained saltwater. The shores were swarming with insects, crocodiles and turtles, some of immense size. Small horses roamed the land adjacent to the lake, along with a large variety of other mammals and birds. Ancient primates lived in the palms, figs, cypresses, and other subtropical plants and trees that grew on the shores. On the cooler mountainsides that surrounded the lake, a dense forest of fir and spruce trees thrived. The area was teeming with life.

One wonders, was this transformation from a jungle of subtropical life to something like we see today done quickly, say perhaps an eon or two, or was the change extremely slow, over the course of several million years? We do know that internal pressures, upheavals, and shifts in the Earth's tectonic plates had much to do with climatic as well as land mass changes, and thus the extinction of many plants and animals. Maybe someday we'll have the answers. In the meantime, we can satisfy ourselves that the Earth most certainly has changed for the better, where we human beings are concerned. I cannot imagine trying to survive in a Cenozoic land. Hominids, if they had lived during that time, quite possibly would have become extinct, as well.

I was up early next morning and eager to get to a fossil quarry. There are four quarries in the immediate area where you can collect your own fossils. Two of those require that you make a reservation. I chose Warfield's simply because they don't require one. Whichever one you choose, call ahead to inquire about road conditions. The weather is another important factor. I would not advise driving on some of these roads during wet weather.

I tried finding the place on my own, but the directions I had were rather vague, so I called them and got somewhat straightened out, but I still had to ask directions from passing motorists. I had passed the secondary road I was supposed to take by several miles. So I backtracked and found the right road.

I made certain that these directions to Warfield's are correct. Take U.S. Highway 189 north out of Kemmerer a short way to state Route 233. The Bureau of Land Management (BLM) office is on the right side of U.S. Highway 189, just before the junction of state Route 233 on the left. From there, go approximately 3.9 miles on state Route 233 to BLM Road 4211. If you cross the Ham's Fork River bridge, you've gone just a bit too far. The BLM sign is not right on the shoulder of state Route 233, but several yards past the junction on the right side of BLM Road 4211. (You can see the Ham's Fork bridge from the junction. It's on an "S" curve.)

continued on next page

BLM Road 4211 is rough and hilly. It's 5.3 miles on this road to Warfield's quarry turnoff. If you are pulling a fifth wheel or camper trailer, I strongly recommend you leave it in town before going to the quarry. I had to drive much of the way in low gear because of the steep hills. There are no signs for the quarry on this gravel road. You will cross four cattle guards along the way. When you come to two piles of cream-colored limestone slabs on the left, this is the entrance to Warfield's. From there it's another mile and a half to the quarry.

There's a steep incline going down to Warfield's from the top of the bluff, so I parked my camper and walked down. I suppose, in retrospect, I could have driven those two city blocks down to the quarry without a problem, but it looked too steep for my rig.

I took my camera bag and fanny pack with a bottle of water and a candy bar. I always wear my sunglasses on a bright day, and it was bright. I arrived quite early, and all indications were that it was going to be another very hot day. The downhill walk to the quarry was invigorating, but coming back up later, possibly with a heavy load of limestone slabs, it would be a bit tiring.

I met Glen Fraser, manager at the quarry, had a chat with him, admired the different fossils in the office, and paid my fee. As of this writing, a half day (four hours) is $50. The quarry is open from Memorial Day through Labor Day, seven days a week, from 8 a.m. to 4 p.m. The office has hammers, chisels, which are needed to split the limestone slabs, and safety goggles. You may also wear a hard hat if you feel the need.

Glen led me over to the edge of the quarry wall where another customer was diligently working. I was shown the proper technique of selecting and splitting rock and recovering the fossils. Glen said he would crouch, lean a slab against his leg, and gently hammer a bit on each corner until a slight crack appeared. Going around the stone a bit at a time reduces the chances of destroying a prize fossil. Then I was on my own.

The limestone at this quarry is a light cream color when dry. As I discovered after a bit of work, the layers of stone down deeper are damp. It splits a bit easier than the dry material closer to the surface.

I soon learned that I would have a hard time bending over for four hours, so I devised a method of my own. I found a waist high shelf that was just right for a work station. I could select a slab from the hundreds that were already loose, place it on the shelf, and gently tap on the chisel all around the stone until it split apart. The waste material – the slabs that don't contain a fossil – must be tossed down to the bottom of the quarry so they can be loaded up and carried away. This was no more than 15 feet from where I worked.

Starting at the middle of a slab, I would try to split it in half. Then, I split the remaining two slabs in half again. The stone is rather soft and a bit crumbly, so great care must be taken while splitting it. There's nothing worse than to see a fish emerge, only to have the slab break apart in your hands, destroying the specimen. But it does happen, as Glen said, even to the best collectors.

A hammer and chisel are all that is needed to recover fossil fish from the Warfield's quarry.

I began to find fossils, mostly fragments at first. Of course, it's a gamble whether you will find them. Much of the material I split was no more than 2 or 3 inches thick. Glen told me that it would be difficult to split the material thinner than ½ inch, and he was right. After an hour or so, though, I could, very carefully, split slabs down to about ¾ inch.

Then, I found my first intact fossil fish. It is beautiful, and I was the first one to see it exposed to the light of day after 50 million years. It's a knightia, 3¼ inches long. I plan to cut the slab in a rectangle and frame it. The carbide-tipped blade on my table saw should do the job if I make very shallow cuts each time.

I found that this work can be a bit contagious. I could hardly wait to split a slab to see if a fish might be exposed. Many of the slabs wound up on the discard pile, but I began to regularly find fossils. One large slab has the remains of a much larger fish in it. By studying the photos of fossils collected at Fossil Butte, I would say that this fish is a phareodus, somewhat resembling our modern-day largemouth bass. The tail and part of the body are intact. The head and forward body parts are scattered across the face of the stone. Maybe a Cenozoic carnivore had lunch before the fish was enveloped in silt.

We are allowed to keep most of the fish we collect. The exceptions are such species as rays, turtles and other rare creatures of the past. They must stay at the quarry. I might add that these fish are two-dimensional – in other words, flat – but they appear three-dimensional, and all are a chocolate brown color against the cream limestone background. In many of the specimens that I gathered that day, the skeletal structure is the only feature that stands out. I noticed, too, that the eyes didn't fossilize as well as the other body parts.

Before I realized it, my four hours had come to an end. I had gathered a nice selection of knightia and mioplosus and one phareodus – 18 slabs in all. The phareodus, had it been intact, would measure at least 14 inches long. The largest slab I collected measures 23½ inches by 17 inches, and not only holds the phareodus, but two mioplosus fossils, as well.

Glen offered to take me and my fossils back up to the camper in his van, otherwise I would've had to make two trips on foot to get all those heavy slabs to my truck. It was lunchtime, and I was hungry. But before I prepared my lunch, I carefully packed my fish.

Glen told me that the best way to carry them is on edge in a box. I packed each piece individually in paper towels, then stacked them in a leaning position in a cardboard box and a rectangular dish pan. The large slab was wrapped separately and leaned against the wall of my camper. It traveled well, and all the pieces came home intact.

Collecting those fossils was a great experience. I had been on digs before, and had collected artifacts, fossil plants, fish scales, invertebrates, and even dinosaur remains on field trips with scientific groups over the years, but this was my first time in the Wyoming Green River formation. My adventure with fossil fish is one that I'll not soon forget.

Warfield Fossils
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2072 S. Muddy String Rd.
Thayne, WY 83127
E-mail: warfosq@silverstar.com
Web site: www.fossilsafari.com

ROCK & GEM

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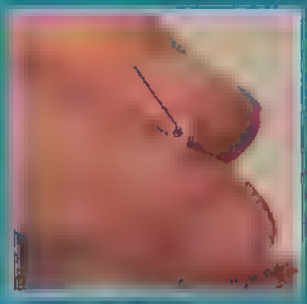
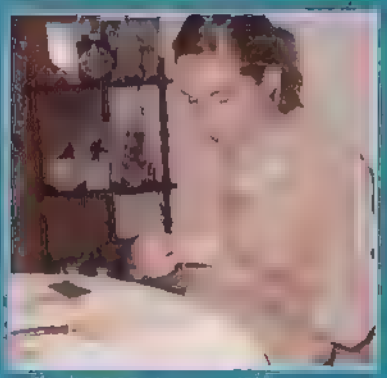


HOW TO DO IT:

WHAT YOU'LL NEED:



KIDS

by Steve Dexter

Choosing a Direction for Your Collection

After you have a number of common minerals in your collection, you begin to realize an important fact. You can't collect everything! You will quickly run out of places to display your lovely acquisitions, and you will have a hard time learning about everything you collect. Therefore, you may need to specialize. Choosing your specialty may be easy if you have one strong interest, or one special collecting locality in your neighborhood where you find most of your mineral specimens.

Some mineral collectors try to collect one certain mineral in all its habits. Calcite, for example, has so many different crystal forms (more than 800 different ones) and is found in so many different localities that you could soon fill your house up with just calcite specimens. Other people specialize in minerals with a common element in them, such as silver or copper minerals.

Collecting minerals from the same mineral group is also a possibility. The garnet group includes several lovely members, such as andradite, uvarovite, spessartine, and demantoid. Another collectable group is the tourmaline group, which includes gemmy elbaite, black schorl, brown uvite, and rare liddicoatite.

Some collectors specialize in gem minerals, such as natural diamonds, emeralds, sapphires, and tourmalines. Of course, they are going to spend a lot for these kinds of specimens, since miners can sell them to jewelers for a lot of money. Often these collectors will display a rough gem crystal with a cut stone from the same material side by side. Less wealthy mineral collectors like you and I may have to settle for the imperfect crystals that can't be made into fine jewelry.

Another specialty is collecting all the minerals from a specific locality. More than 200 different mineral species have been found at the Tsumeb Mine in South Africa, and Tsumeb is the type locality for more than 50 species. (A type locality is the place a mineral is first described and named.) Some collections are filled with minerals from one general area, such as a state or country. Many of my friends have collections of Arizona minerals, since that is where we live, and Arizona has a lot of mines that produce fine specimens.

Some collectors put together "systematic" collections that have one specimen of each valid mineral species. This can be very difficult, since many mineral species are only found as microscopic specimens, and new species are recognized each year. Some rare minerals just look like globs of dirt, so they are not much fun to collect and they can be very difficult to identify without complex testing. Other minerals may be poisonous or radioactive, so you need to take special precautions in storing them to protect your family.

Collectors who are most interested in crystallography might concentrate on minerals that show good crystal structure or special twinning characteristics. Others might specialize in pseudomorphs, crystals that have changed their chemical composition over time, but retained their original crystal shape.

Micro-mounters are collectors who carefully trim and mount tiny specimens to be viewed with a microscope. While this may seem tedious, often the tiniest crystals are the most perfect and lovely specimens of all! Micro-mounters can keep thousands of specimens in a set of drawers in an apartment, and may have the rarest species in their collections. They also have the easiest time moving their collections when it becomes necessary.

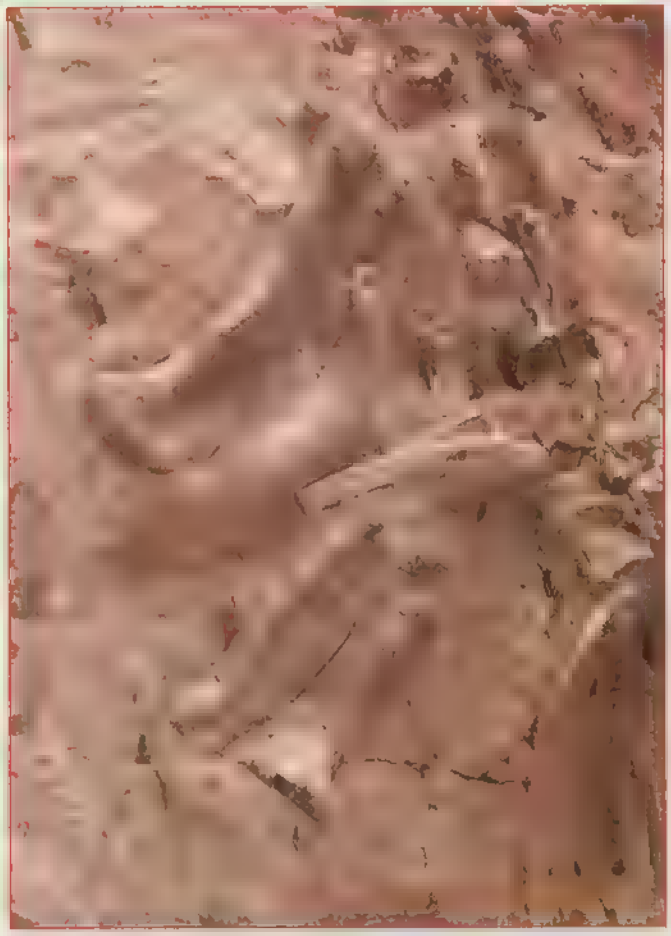
I am very partial to beryl crystals, such as emeralds, aquamarines, heliodors, morganites, and red beryls from Utah. I try to find crystals that are pleasing to see, representative of their species, and tough enough to allow my friends to handle them without worrying about damage.

I am very proud of the minerals I have been able to collect in the field. I value a specimen I collected with my friends over a nicer specimen that I purchased. Self-collected specimens mark milestones in my collecting career and bring back memories of good times and good friends sharing a good hobby!

Rock & Gem Kids Quiz

[illegible] Rock & Gem Kids Quiz [illegible] coming to open to U.S. residents age 11 and younger. All [illegible] by carefully reading the column. Write your answers [illegible] postcard or 4X6 card and mail to Rock & Gem Kids Quiz, P.O. Box 6925, [illegible] 93006-9899. Valid entries received by June 30, 2005 will be entered in a drawing from which five winners will be chosen. Valid entries must be [illegible] and must include the [illegible] and the signature of a parent or guardian. Prizes are generously provided by the Arizona Mineral [illegible] Mining [illegible] Foundation.

1. [illegible]
2. What is a type locality?
3. [illegible]
4. [illegible]
5. [illegible]



Massive dinosaur bones show the spectacular preservation of the fossils at Dinosaur National Monument.

AMERI FOSSIL PARKS

Eight National Parks Take You Back in Time

Most U.S. citizens know our national park system protects the geysers of Yellowstone, the forests of the Smokies, and the swamps of the Everglades. But some lesser-known national parks give us the ability to go back in time — not just to the recent past, but to almost unimaginably deep time, many millions of years ago. Sensational assemblages of fossils are accessible to the public in these parks. Equally important, the parks have active paleontological research programs, which add every day to our understanding of the past.

Although fossils have been found in more than 150 of our parks, only eight National Park Service parks are devoted to the protection of fossils. Each of them enables us to experience concrete, tangible evidence of ancient life and environments. When you visit, keep in mind that it is illegal to collect, remove, or even disturb any fossil in a national park, except under a valid research permit issued by the park superintendent. While our time travel might be imaginary, the fossils protected in America's national parks are not. Some of the plants and animals of the distant past were so different from the life we know it is hard to believe they were real. Visit these fossil parks, and believe it.

PETRIFIED FOREST NATIONAL PARK

America's "forest" fossil park, Petrified Forest in Arizona, takes us back an almost incomprehensible 225 million years to a seasonally dry landscape with forests, rivers and streams. The dominant tree was Araucarioxylon, growing up to 200 feet tall. Over time, trees died and fell. Wet cycles brought floods powerful enough to move large tree trunks, depositing them in river channels and on floodplains.

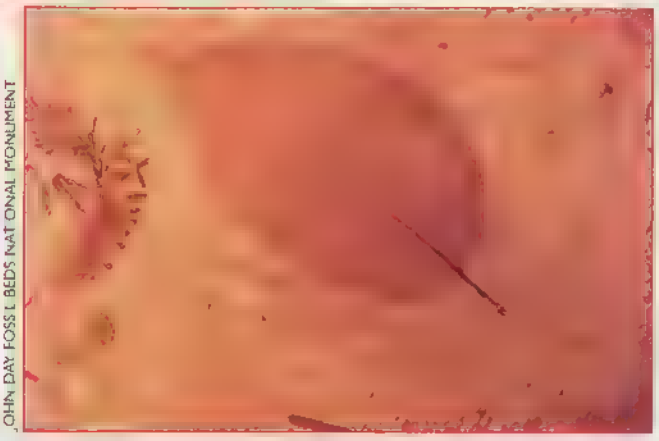
Some of the trees were buried in sediments before they could decay, and were fossilized by silica replacement. They are now one of the largest concentrations of petrified wood in the world. Almost anywhere in the park, visitors can see the trees in impressive numbers and size — and spectacular beauty. Several forms of iron, carbon and manganese teamed up with the silica to make this fossilized wood some of the most colorful anywhere. But it's not just color; the minerals gradually replaced each cell wall, preserving in exact detail the structure of the wood.

Triassic forests sheltered many animals. It was the beginning of the age of dinosaurs. These early dinosaurs were not yet large or numerous. They walked softly because they shared their world

Visitors to Fossil Butte National Monument's Research Quarry frequently uncover fossil fish like this Diplomystus.

RICA'S

tory and Photos
by Judy Lundgren



JOHN DAY FOSSIL BEDS NATIONAL MONUMENT

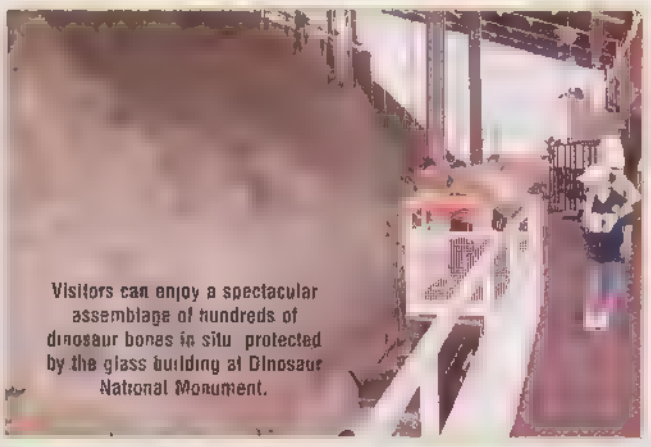
Beautifully preserved fossil leaves found at John Day Fossil Beds National Monument include Metasequoia (left) and Alnus (center).

A fossil tree trunk dwarfs a visitor to Florissant Fossil Beds National Monument, which preserves many trees of this size

with much bigger predators. The T. rex of the Triassic was not a dinosaur at all, but the toothy 13-foot reptile Postosuchus. While Postosuchus ran rings on land, the rivers held Phytosaurs, alligatorlike reptiles up to 30 feet long. The Phytosaurs fed mostly on fish and smaller aquatic animals, but little dinosaurs like Coelophysis must have been wary when drinking.

Paleontologists, over time and using many specimens, have pieced together several of the animals to assemble large mounted skeletons. The Rainbow Forest Museum in the visitor center at the south end of the park is the best place to see these striking creatures.

An exciting recent find at Petrified Forest is the partial skeleton of Coelophysis bauri, the most complete dinosaur discovery



Visitors can enjoy a spectacular assemblage of hundreds of dinosaur bones in situ, protected by the glass building at Dinosaur National Monument.

in the park since the mid-1980s. Future studies will investigate a recently discovered transition between earlier and later animal groups.

DINOSAUR NATIONAL MONUMENT

This Utah park contains the premier dinosaur site on public display anywhere. It has more species, and more individual dinosaurs, than any other dinosaur locality on earth. The quality of preservation of the fossils is elegant. The sheer size of the site, and the size of the animals, challenges the mind.

About 150 million years ago, at different places along an ancient river in what would become northern Utah, dinosaurs and other animals lived and died. Flowing water carried some of the bodies and they accumulated on a sandbar. Before scavengers could scatter the bones completely, and before too much decay, the bodies were covered by sand. Slowly, the dinosaurs became fossils.

And what fossils. This single quarry filled the dinosaur gallery at the Carnegie Museum of Natural History in Pittsburgh, and other museums, with huge Sauropod dinosaurs. And that was just the beginning. After many years of digging and research, paleontologists finally stopped working the quarry, leaving it sheltered under a two-story building as a fantastic exhibition. From two observation decks, visitors can see more than 1,600 bones, large and small. Take binoculars and buy the inexpensive guidebook *What Kind of Bone is That? A Guide to Fossil Bones of the Quarry* at the quarry bookstore. Once your mind has stopped boggling, you will want to work out the intricacies of the jumbled pile and see the smaller details.

continued on page 55

Fossil Butte National Monument has a unique program in which visitors can uncover fish and other fossils

Some of the bones are articulated (jointed together as when the animal was alive), but most are scattered. Camarasaurus, Diplodocus, Apatosaurus, Stegosaurus, Allosaurus, Camptosaurus, and Barosaurus are all here. A spectacular complete Camarasaurus skull with neck vertebrae is easy to make out. With some patient observation and a little practice, following the map in the book, you can find the scattered bones of a nearly complete, but disarticulated, Stegosaurus.

While paleontologists have ended excavation in the quarry, their research in other areas of the monument has continued with the multi-disciplinary work of the Morrison Ecosystem Project. This research has looked not only at dinosaurs, but at microfossils, invertebrates, small vertebrates, fossil soils, trace fossils (i.e., footprints), pollen, and the geology of the surrounding rocks for a more complete picture of the environment of the dinosaurs.

JOHN DAY FOSSIL BEDS NATIONAL MONUMENT

Because John Day Fossil Beds National Monument in Oregon preserves three widely separated time periods in its fossil-bearing formations, we get a unique look at more than 40 million years of the Age of Mammals at one location.

A lot can happen in 40 million years. The earliest habitats were tropical to subtropical forests. Thousands of fossil plants—covering hundreds of species—are preserved virtually completely, including fruit, seeds and nuts, roots, branches, and leaves. This foliage supported many animals, including large browsers like Brontotheres and Amynodonts, as well as many smaller animals and their attendant predators.

Plant fossils indicate a change from tropical to deciduous forests from 37 million to 20 million years ago, the Early Miocene Epoch. The more than 100 extant groups of mammals included horses, rhinos, sheep-size herbivores called oreodonts, camels, pigs, rodents, dogs, and cats. Volcanic ashfalls deposited tuff layers that can be radiometrically dated. The combination of high plant and animal diversity, with the ability to date them, provides scientists an exciting look at rates of change as life evolved.

About 15 million years ago, grasslands and mixed hardwood forests began to dominate. Some animals, such as horses, adapted to grasslands, others, like deer, bears and weasels, stayed with forests. The latest fossils found at John Day, from about 8 million to 6 million years ago, include horses, rhinos, camels, peccaries, pronghorns, sloths, dogs, and bears. There are many more grazing than browsing animals, indicating more grasslands and a drier, cooler climate.

Scientists continue to research changes in the compositions of plant and animal communities, using ancient soils to gauge former temperature conditions, and dating the last known occurrence of a fossil primate in North America.

The Thomas Condon Paleontology Center at John Day Fossil Beds National Monument opened to the public in December 2003. The design emphasizes the scientific process, with a viewable laboratory, curation and storage areas, a classroom, theater, and exhibits. New exhibits are scheduled for completion in mid-2005. Raw scientific data will be transformed into rich, detailed depictions including land-

continued on next page

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scapes, plants, and animals from eight slices of time about 5 million years apart. This promises to be one of the best spots on the continent for seeing extinct animals brought to life, and for understanding the importance of paleontological discoveries.

FOSSIL BUTTE NATIONAL MONUMENT

Fossil Butte National Monument preserves a small fraction of the sediments laid down in a lake and river system 50 million years ago. The smallest of three ancient lakes, Fossil Lake, covered about 900 square miles of what would become southwestern Wyoming. The limestone sediments of Fossil Lake buried large numbers of dead fish and other organisms before scavengers or bacteria could disintegrate them. The preservation of the organisms is spectacularly complete. The large number of intricately detailed and diverse fossils embodies an entire paleoecosystem.

Fossil Butte is justly famed for its fish, but many other organisms found their way to the bottom of the lake. Perhaps the most remarkable is a small bat, Icaronycteris. Its discovery pushed the time of the earliest known bat back by millions of years. Fossil eaves, flowers, frogs, insects, and a single snake are beautifully displayed along with many kinds of fish, in the museum at Fossil Butte's visitor center.

Fossil Butte offers a unique opportunity among America's fossil parks. Visitors can assist, hands on, with excavation and data collection at the monument's research quarry. Guided by monument staff, they can find a fossil fish and other organisms, identify them, measure length and orientation, and help to complete a record that shows how environments and animals evolved over time. Specimens collected at the quarry are housed in special facilities at the monument along with their data. They will be available for scientific study permanently, so visitor participation is a lasting contribution to science, as well as a matchless experience of discovery. Supported by the Geological Society of America, the research quarry program is available (weather permitting) on weekends from Memorial Day through Labor Day.

In addition to the monument's research quarry, Dr. Paul Buchheim of Loma Linda University, California, has maintained long standing studies of the sediments and paleoecosystems of Fossil Lake. Dr. Lance Grande, curator of fossil fishes for the Department of Geology of the Field Museum of Natural History in Chicago, conducts research on the fossil fish.

The public may legally collect for a fee or buy common specimens at many commercial quarries in the area around Fossil Butte, however, scientifically important specimens found must be given to the state of Wyoming.

Visitors to Dinosaur National Monument enjoy mounted skeletons and can view a massive quarry wall containing thousands of dinosaur bones.

FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

This monument was named Florissant, which means "flowering," before anyone knew it would contain fossil flowers. About 34 million years ago, mudflows caused by water saturation of volcanic ashfalls buried a redwood forest growing along a stream. One of the flows dammed the stream and created a lake.

Lake Florissant lay in a warm, humid forested valley. The forests held many trees we would recognize today: redwoods, cedars, pines, maples, hickories, elms and oaks. Fish, mollusks, birds, mammals, and many insects were at home there.

Today, Colorado's Florissant Fossil Beds National Monument preserves two sets of fossils. The mudflows surrounded and preserved the lower parts of huge redwood trees. Dissolved minerals from the volcanic rocks permeated the wood, precipitating silica within the cell walls. The other set of fossils formed in the lake. As volcanic eruptions continued from time to time, thousands of plants and insects in the lake were buried in layers of fine grained sediments. The sediments became shale and preserved the organisms within it in finest detail. At this national monument, you can see massive petrified stumps and some of the smallest insect fossils.

Lake Florissant was 15 miles long, and the number of fossils it holds is staggering. More than 60,000 specimens have been collected for museums and universities. More than 100 species of plants are preserved as stems, flowers, seeds, cones, and pollen. Because they are so fragile, insects are seldom preserved as fossils, but Florissant has more than 1,100 species! Beyond numbers, these fossils are known for their exquisite detail and great beauty. Many of them can be seen in the visitor center. A selection of the best is photographed and described in *The Fossils of Florissant*, a recent book by Herbert W. Meyer. This book is well worth a look before you go to Florissant.

During the summer of 2003, Marie Worley of the University of Colorado, Boulder, investigated a little-studied mudstone layer that lies below the lake shales. In it she found many rodents, rabbitlike lagomorphs, and insect eaters, as well as somewhat larger mammals, such as the deerlike browser Leptomeryx. An exciting find was a single tooth from a very large Eubrontothere. Previous knowledge of Florissant mammals was restricted to a few that had been unfortunate enough

to fall into the lake. Worley's study revealed the diverse community that thrived at the time the lake formed.

A commercial quarry near the monument lets paying visitors find Florissant fossil insects and plants for themselves. The quarry also participates in scientific research. Florissant Fossil Beds National Monument, the Denver Museum of Nature & Science, and a local school system recently teamed up to excavate a section donated by the quarry. The project provided new information on plant, insect, gastropod, and mollusk diversity.

BADLANDS NATIONAL PARK

Layers of sand, silt, clay, and volcanic ash have been eroding for millions of years, creating the spectacular mounds and pinnacles known as the badlands in parts of South Dakota, Nebraska, and Wyoming. Badlands National Park, in South Dakota, protects a small part of the White River Badlands. It's a place where vegetation has a hard time getting a foothold. Fossils are easily revealed as they erode out, and there are many of them.

The earliest rocks of Badlands National Park go farther back, around 75 million years, and record a shallow Cretaceous sea inhabited by marine invertebrates. Baculites (an extinct cephalopod), clams, crabs, and snails occupied the shallows in great numbers. But by 37 million years ago, the region had become a warm, wet plain with many streams and rivers. Forests and swamps sheltered countless animals, including mammals, reptiles, and birds. In their turn, the lush forests gave way to savannas and grasslands, with a drier climate and a different set of animals.

Go to Badlands National Park for fossil invertebrates, reptiles, and birds, but above all, go for the mammals from the Oligocene, around 25 million years ago. Many resembled animals we know today, but with a twist. Mesohippus, a horse with three toes on each foot; Hoplophoneus, a saber-toothed "cat" that wasn't a cat; and the rabbitlike Prelolagus, which was perhaps the ancestral bunny. There were also huge piglike animals, various rhinos, and Leptomeryx. Even camels were found here, though they differed in several respects from the ones we know today. Judging from the numbers of their fossils, which indicate vast herds, the most common mammal was the oreodont. Turtles were also abundant.

The Ben Reifel Visitor Center, which features exhibits on the fossils, is scheduled for remodeling and updating, and is expected to be completed in about two years. The new exhibits will focus on geologic history and different paleontological sites found within the park.

Badlands National Park has agreements with several universities for paleontological research. A recent cooperative effort between the park and the South Dakota School of Mines and Technology demonstrated scientific mapping and excavation of vertebrate fossils at a unique site to more than 5,000 visitors in a single season. The "Pig Dig," as it was known, was named after Archaeotherium, a large, piglike creature found in abundance there. Large bones of the rhinoceros Subhyracodon were also excavated, as well as delicate and tiny bird and carnivore bones.

AGATE FOSSIL BEDS NATIONAL MONUMENT

Agate Fossil Beds has a somewhat remote location in the Niobrara River Valley in northwestern Nebraska, but it's well worth the trip. During the Miocene Era, the area was similar to today's Serengeti Plains of Africa: grass savannas dotted with trees. Many mammals populated the diverse ecosystem: herds of small horses, rhinoceroses, piglike Entelodonts, odd-horned beasts, and camels. There were also predators: coyote- and wolf-sized dogs, predatory birds, bear-dogs, and various catlike hunters. Occasional river floods preserved abundant bones. Agate also records a changing climate. Conditions became drier, and browsing animals like the horse Miohippus gave way to those who could graze on drought-tolerant grasses. Parahippus, an ancestor of modern horses, could both browse and graze, so it was well prepared for the change.

Some of Agate's animals were quite unusual, bordering on the extreme. The small, but impressive, museum at the monument offers a close look at mounted skeletons of some of the more exotic mammals. Most imposing is the tall, bizarre chalicothere Moropus. Chalicotheres were perrisodactyls (the same group as horses), but sported huge claws, front and back, that were retractable, like those of a cat. It looks as though it could dig, but it lacked any other skeletal adaptations of diggers.

Don't miss the short hike to the spiral burrows dug by the large land beaver Paleocastor. These fossil traces, called "devil's corkscrews," mystified paleontologists until skeletons of the beavers were found in them.

For a lively field trip to the life and times of Agate, visit the U.S. Geological Survey site at www.npwrc.usgs.gov/resource/1998/agate/visit.htm.

HAGERMAN FOSSIL BEDS NATIONAL MONUMENT

River and floodplain environments around the edge of an ancient lake left layers of sand, silt, and clay at least 600 feet thick at the site of Hagerman Fossil Beds National Monument in Idaho. The climate of 3 million years ago was wetter and had more vegetation than today.

The best-known fossil at Hagerman is Idaho's state fossil, the Hagerman horse, Equus simplicidens. Unlike horses at many earlier fossil sites, it had only one toe on each foot. It is the earliest representative of the genus Equus (horses, donkeys, and zebras) found so far. Details of the chewing surfaces of its teeth, as well as some parts of the skull and skeleton, point toward a link with the modern Grevy's zebra. Perhaps it was even striped like a zebra. Hundreds of specimens have been found, providing paleontologists with a rich database that includes male and female individuals of all ages. From this many examples, scientists can work out population and ecological structures, as well as some behavioral dynamics of the horses.

Horses are not Hagerman's only claim to fame. A variety of habitats, from dry plains to river and lake environments, ponds and forests, created a great diversity of aquatic and terrestrial plants and animals. More than 180 mammal species and 35 plants have been found. There were fish, frogs, snakes, and birds. Along with the horses were many other mammals: mastodons, camels, llamas, antelope, deer, ground sloths, beavers, and muskrats. Of course, predators of all sizes (owed saber-tooth cats, hyenalike dogs, and otters among them. Go to www.nps.gov/hafo/paleontology.htm for entertaining stories by monument paleontologist Dr. Greg McDonald about the animals found at Hagerman.

Scientists have published more than 200 scientific works on the Hagerman fossils. Recent research is wide ranging, including climate change using fossil pollen, ecological studies, work on fossil reptiles, amphibians, cats, beavers, muskrats, and other animals, as well as processes of fossilization, and even DNA studies of fossil woods.

Significant fossil sites are seldom open to the public, but all of us can explore millions of years of deep time at these eight magnificent parks. For detailed information and help planning your visit, go to www.nps.gov.

FIELD TRIP

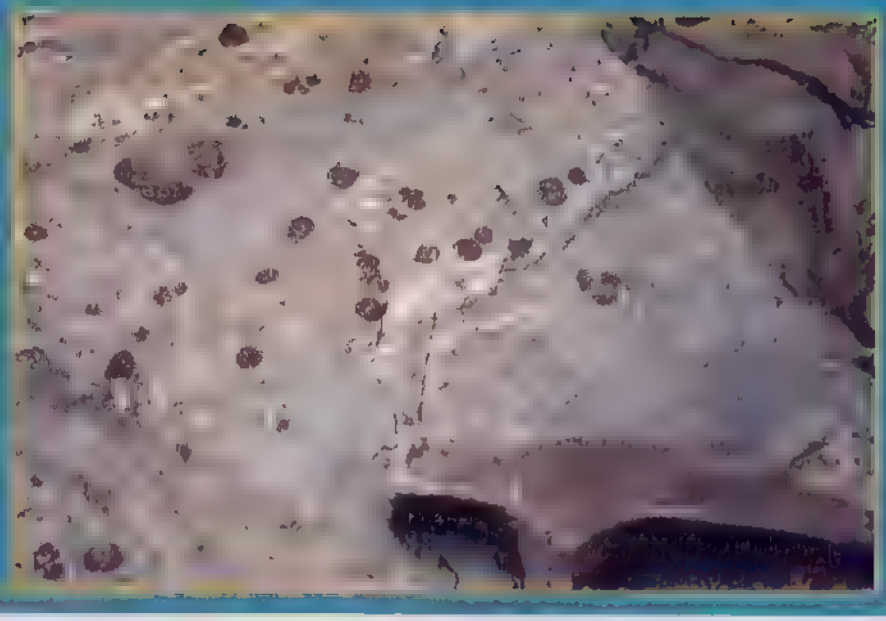
Bellows Falls SILLIMANITE

"Turkey Tracks" on the Banks of the Connecticut River

The "turkey tracks," polymorphs of sillimanite after andalusite, form striking patterns on the gneissic rocks at Bellows Falls

Rivers, like road cuts and quarries, can offer excellent collecting opportunities. Rivers are usually accessible, as many states have laws permitting access for fishing, boating, and other recreational uses. Rivers often have good exposures, as the water has often washed away the soil and has exposed bedrock structures. And perhaps most importantly, rivers are enjoyable to visit. When you want to take your family out and do some collecting at the same time, it is much easier to say "Let's go to the river!" instead of "Let's go to the borrow pit!"

Freshly exposed garnets are gemmy and striking in bright sunlight



Round, reddish-brown garnets are common throughout the gneiss and form attractive patterns in outcrops.

If you are vacationing in southern Vermont or New Hampshire and want to check out an easily accessible and interesting site along a river, the Bellows Falls collecting locality along the Connecticut River is an outstanding choice. Bellows Falls is in Windham County, in southern Vermont, on the west side of the Connecticut River which forms the border between Vermont and New Hampshire. The town is located just east of Interstate 91, which is the principal north-south highway through Vermont. Families returning from the White Mountains that want to squeeze in one more collecting/sightseeing trip will likely find that Bellows Falls is a very good stop.

The Bellows Falls locality offers a unique opportunity to collect "turkey track" sillimanites. These are sillimanite pseudomorphs after andalusite. They are called turkey tracks as they form a striking pattern that resembles bird tracks in the gneissic host rock. Red-brown garnets in many of the rocks are a nice complement to the sillimanite.

The best collecting of the turkey track sillimanite is on the west bank (the Vermont side) of the river just south of a power plant. The turkey tracks are found in loose rocks along the riverbank; the white "tracks" on the gray rocks are easily spotted. The sillimanite is best seen on weathered, rounded surfaces, and there are literally millions of pieces along the river.

The east side of the river, which is the New Hampshire side, also offers a unique collecting opportunity. The bank below state Route 12 is covered with a vast amount of riprap, which consists mainly of large pieces of dark gneiss. The riprap was laid down to protect the bank, but it's well above the water line of the river. Many surfaces of the gneisses are mineralized with stilbite, and radiating white crystals can be found with minimal effort. All you need is a good hammer and chisel to remove them.

The Connecticut River narrows to a rocky gorge between Bellows Falls and Walpole, New Hampshire. Native Americans gathered seasonally at the great falls in the gorge to harvest migrating salmon and shad. In the 18th century, the village of Bellows Falls was established on the west side of the river. The location was the site of one of the first bridges across the Connecticut River since the river was so narrow there. Water meant a source of power, and small mills and other concerns were able to locate in the area. As the industrial revolution developed, the area became an industrial hub of railroads and paper factories. Today, these industries are all but gone from the region, and tourism and service businesses are the principal industry.

The geology of the Bellows Falls area consists mainly of gray schists of the Rangeley Formation of the Central Maine Terrane and the Bethlehem Gneiss of the Bellows Falls Pluton. Metamorphic terranes can be extremely complicated, and it is often difficult to understand the geology even where the rocks are well exposed. The Connecticut River gorge at Bellows Falls is no exception, as the rocks are highly metamorphosed and structurally complex. An excellent account of the geology of this region is provided in *Vappes, Gneiss Domes and Plutonic Sheets of West-Central New Hampshire* by Dr. Tim Allen at Keene College in New Hampshire. It is available online at http://kilburn.keene.edu/Research/WestCentralNH. This is a field trip guide and covers many other interesting areas in Vermont and New Hampshire.

However, even when the stratigraphy and structure are difficult to decipher, the mineralogy can often provide important information. The sillimanite in the rocks at Bellows Falls can tell petrologists a good deal about the metamorphic history of the area. Sillimanite is one of the three "Al_2SiO_5 polymorphs," and forms at a defined pressure and temperature range. Polymorphs are minerals that have the same formula, but different mineralogical characteristics. Kyanite and andalusite are the other Al_2SiO_5 polymorphs. Sillimanite forms at the highest temperature and pressure, andalusite at the lowest temperature and lowest pressure, and kyanite at the lowest temperature and highest pressure.

To form the Al_2SiO_5 polymorphs, the parent rocks must be of the appropriate composition. Aluminous sediments are a typical parent material. In high-temperature, regionally metamorphosed areas, such as a deeply buried metamorphic basement complex, sillimanite tends to form. Andalusite is most frequently found in contact metamorphic aureoles, such as may result when granitic magmas have intruded aluminous schist. Kyanite is found in areas that have been subjected to high pressures, but low temperatures, such as buried aluminous sediments that are compressed within a deep subduction zone. Identifying the Al_2SiO_5 polymorph in the context of the mineralogy and fabric of the rock can provide important information about the geologic history of a region.

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At Bellows Falls, various geologic workers have determined that the sillimanite has been determined to be pseudomorphous after andalusite, and this forms the "turkey tracks." The sillimanite has been described as occurring within the schists of the Rangely Formation, while the garnets occur in the Baltimore gneiss. To further complicate matters, the schists of the Rangely Formation appear to be gneissic in character, at least to me, and it can be difficult to distinguish them from the Baltimore gneiss. The presence of sillimanite after andalusite indicates that the rocks underwent additional metamorphism at significantly higher temperatures.

Sillimanite sometimes occurs as fine, needle-shaped fibers. This can give it a fibrous look, and the mineral is also known as fibrolite. This fibrous form, combined with the elongated crystal habit, give it the "turkey track" appearance observed at Bellows Falls. Fortunately, while it may appear fibrous, it is not fibrous like asbestos minerals, and I have never heard anyone associate sillimanite with the problems linked to asbestos. Interestingly, while both the Al_2SiO_5 polymorphs and asbestos have heat-resistant properties that make them valuable in the refractory and fireproofing industries, only asbestos is well known as a health hazard.

While found around the world, sillimanite is one of the few minerals named for an American mineralogist. It was named in 1824 in honor of Benjamin Silliman, who was a professor of chemistry at Yale University. Silliman's impact on science and geology was profound, and it is only fitting that his name be remembered through such an important mineral.

In addition to its mineralogical significance, sillimanite has important industrial uses. The three Al_2SiO_5 polymorphs are highly refractory. This means that the minerals have an extremely high melting point. They can be used as a raw material to make bricks for lining furnaces and other applications in which resistance to high temperatures is needed. Although the Al_2SiO_5 polymorphs in themselves are very heat resistant, they are processed into refractory materials by further heating. When calcined, or broken down into individual oxides by heating, the minerals produce a mixture that is 12 percent silica (SiO_2) and 88 percent mullite ($3Al_2O_3 \cdot 2SiO_2$). Mullite is extremely refractory, has a small coefficient of expansion, and can handle abrasion and slag erosion. Mullite is the material that is actually required by the refractory industry. Natural mullite, where calcination has occurred through metamorphism, is found on the Isle of Mull off the coast of Scotland, hence the name. However, natural mullite has never been found in quantities that can be commercially mined. Other aluminous materials and minerals, such as bauxite or kaolin, can also be used to produce mullite synthetically by fusing or sintering.

The refractory business has been difficult lately, especially with the tough times in the steel industry. Other uses for the sillimanite minerals include abrasives, constituents for glazing, and in nonslip flooring. Since the sillimanite minerals have a high proportion of alumina, these minerals have also been used as a source for producing aluminum during wartime, when the more easily processed bauxites were not as available to the United States.

My family and I have traveled to the Bellows Falls locality twice. The first time was in June 2003, when returning from the Gilsum, New Hampshire, Rock Swap, and the second time was in June 2004, when returning from the White Mountains. Both times it proved an easily accessed area that the kids and my wife enjoyed.

The area is very easy to access. I learned about the area from the article "Vermont Mineral Locality Index," by Vandal T. King and Janet W. Cares, in the September/October issue, Volume 71, of *Rocks & Minerals*. This publication did not have any maps, but since the site was on the Connecticut River and near the village of Bellows Falls, it seemed that it would be easy to find. This publication also reported that chabazite, prehnite, drusy quartz, and pyrite were present in the area.

During low water at Bellows Falls, a vast amount of rocks are exposed to collectors.

During our first trip in June 2003, we were easily able to find the main parking area to the site. On the west side of the river, just west of the Vilas Bridge, which crosses the Connecticut River, we turned south on a small road that headed south. It ended at a parking area/turnaround that was next to a power plant. During this trip there were other cars parked in the area, so it appeared that there were no issues with parking and hiking around the area.

We climbed down a steep slope and then walked over the boulders to get to the river. The kids thought this was one of the best parts of our trip, as they were able to climb on the rocks along the river. Many of the boulders are quite large and most are rounded. It can be easy to twist an ankle, and there are occasional pieces of metal debris, such as rebar in pieces of concrete, scattered among the rocks, so you do have to be careful. However, it is generally a good place to bring kids, as the rocks are smooth and have enough traction for walking and climbing.

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It is also important to note that as this area is near a power plant there is also the potential for the area to be flooded on short notice. There is a sign that says, "Warning. Changing water levels. Be constantly on the alert for water level increases. Water upstream may be released at any time." There were also signs indicating that no fishing is allowed in the area of the tailrace below the powerhouse, but according to the diagram on the sign, we were well away from the tailrace. We still saw people fishing in the rocks downstream from the parking area, and some of the fisherman brought out some very large smallmouth bass and walleyes. There are no signs indicating that the area along the river is private property or that rock collecting is prohibited.

The weather was perfect during this visit, and the water levels appeared quite low. Like most sites we visit for the first time, I was not sure what we were to look for. However, we soon found several large, rounded pieces of gneissic rocks with a remarkable pattern of roughly rectangular bluish white minerals oriented in generally the same direction. These were the "turkey track" sillimanites.

The turkey tracks also show how sillimanite got the name fibrolite. As opposed to sharp, even edges, the ends of the sillimanites were often jagged. Close inspection shows that they resemble small, compact masses of fibers. They are white to light blue, and the host rock gneiss is light to medium gray. The gneiss has extremely fine-grained biotite and muscovite flakes, and these give the rocks a sparkling appearance in bright sunlight.

In addition to the sillimanite garnet is another attractive mineral at this site. The garnet is generally found as rounded porphyroblasts in the gneisses. Porphyroblasts are minerals in a metamorphic rock that grew in place as the rock was metamorphosed, and they are like the metamorphic equivalent of phenocrysts in an igneous rock. Under a microscope, they can tell a great deal about the history of a rock, as they often show rotation patterns and have compositions that vary with heat and pressure.

While many of the garnets are red-brown, some of the large boulders in the river bed have surfaces with gemmy, light red garnets. A few of these can be broken out with a hammer and chisel, but more often the surfaces are large, flat, and hard, and are best left in place. The best way to find good garnets is to look for rounded clasts with a red to purple tinge. It takes a little effort, but we were able to find some nice rocks that are filled with garnets. It is interesting to note that the rocks with the garnets did not have significant amounts of turkey track sillimanites, which indicates that the garnet and sillimanite gneisses may vary in both composition and metamorphic history.

Rounded rocks loaded with garnets are easily found along the river.

During this trip in 2003, we did not get the chance to check out the reported minerals in the riprap on the east side of the Connecticut River. We returned for a follow-up visit in June 2004. Not surprisingly, the area had not changed, and we started with re-exploring the west side of the river, since we knew this had good sillimanites. Once again, the kids enjoyed climbing on the rocks, and we found some nice garnets in addition to the sillimanite. This time we really loaded up on sillimanite rocks, since they made such excellent display pieces and stepping stones in the garden.

I had hoped it might be possible to wade across the river to get to the east side, but the river is far too wide and deep in even its narrowest places. We drove over to the east side, but there are no good parking areas near the riprap. We took the first road that we could south of the riprap, and this leads to an area that is like a park/picnic area with several trees. There is a lot of shade here, and it is a good place to set up a base for exploring the east side.

By now, my wife and kids were through with rock collecting, and wanted to stay in the car while I checked out the riprap. The only way to get to the riprap was to bushwhack through thick grass, but fortunately it was mostly grass and not briars. Collecting in the northeast during the summer months is often complicated by the thick vegetation, and this area was no exception. I also noticed that there were several pieces of sillimanite-bearing rock in this area, indicating that you could find turkey tracks on the east as well as the west side.

I soon reached the riprap, and almost immediately I found some nice pieces of stilbite. The white stilbite forms striking radiating patterns on the dark gneissic riprap. The host rocks are extremely hard, and it was challenging to break off pieces to minimize rock size and weight while preserving the best of the stilbite. The area is also positioned so that the afternoon sun is focused on this area. It was not long before I was soaked in sweat from banging on these rocks.

I only had time to explore a small portion of this area, but I could see that the riprap extended for hundreds of feet, and was at least 100 feet wide. It is like a huge mine dump of fresh material. The zones of stilbite are easy to spot, as they are white against the dark gneiss. The gneiss is extremely hard and sharp, and you need a good hammer, chisel, gloves, and safety glasses to collect this material. Without gloves, your hands will take a terrible beating, and without safety glasses, the hammering is a real danger to your eyes and face. This likely also the area from which prehnite and chabazite are also reported, and with luck one may also find some pockets of these minerals.

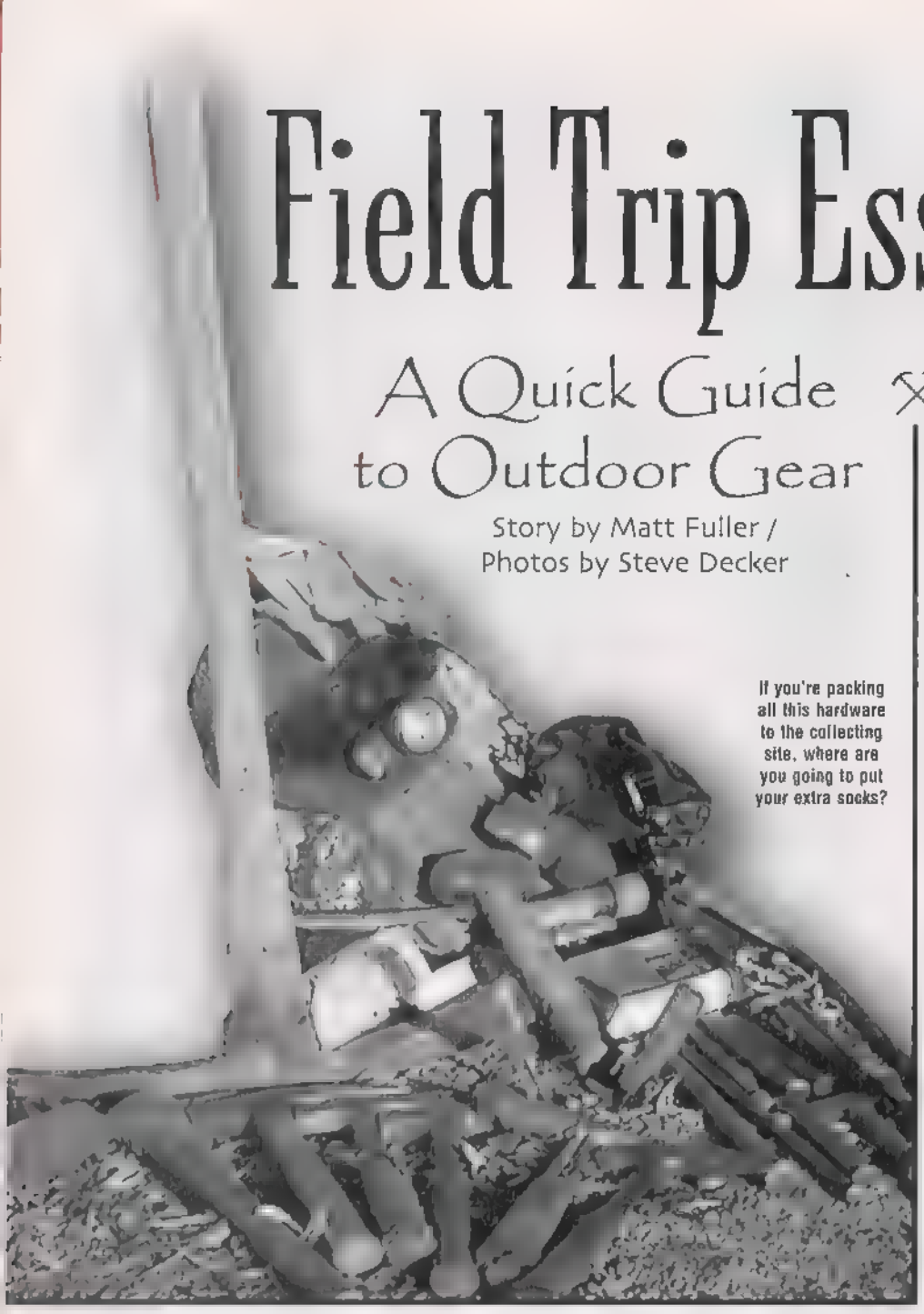
The east side collecting area is an easy area to find good stilbite, but it takes a great deal of hammering to get the best material. It is best for older kids and adults who do not mind a little hiking and work to get their minerals. This area is also well above the high-water area, so if the river conditions preclude collecting on the west side, one can be assured of the east side for a collecting trip.

The Bellows Falls locality is a worthwhile stop if you are in the area. To get to the site from Vermont, take U.S. Highway 5 to Bellows Falls and turn south on a small road just before crossing Villas Bridge over the Connecticut River. If you are coming from New Hampshire, take state Route 12 to Villas Bridge, and take the first turn south after crossing the bridge. If you also decide to collect at the riprap, you can easily see it on the west side of state Route 12, just south of the bridge. You will be assured of finding some excellent "turkey track" sillimanite and brown to pink-red garnets on the west side of the river, and nice pieces of stilbite on the east side of the river. Few places offer such a combination of collectible minerals at a site that requires no advance arrangements or extended hiking. The scenery is hard to beat, so even if you are with someone that has no interest in minerals, you can still justify a trip to this site.

Field Trip Essentials

A Quick Guide to Outdoor Gear

Story by Matt Fuller /
Photos by Steve Decker



If you're packing all this hardware to the collecting site, where are you going to put your extra socks?

When you're planning a field trip, how do you determine the best equipment to take along? Sometimes, it's as simple as throwing your digging tools in the truck and hitting the road. Most times, however, a little preparedness can pay off big in convenience. Having the right equipment at your fingertips will make the difference between a successful collecting trip and a long, miserable walk.

The minerals you hunt will largely determine the environment you'll be in, along with the supporting gear you take for your field trip. With this in mind, I've distinguished between tropical climates like those found at lower elevations near both coasts, deserts, and semialpine environments such as those present in the Rockies and at high elevations elsewhere.

CLOTHES

Since wool is good at wicking moisture and retaining warmth when it's wet, it's workable for most situations anywhere. Nylon socks are my favorite for desert travel as long as I have a pair of gaiters to keep sand out. Use them as an inner sock if you wear heavy boots. There's less friction with nylon, which means fewer blisters when your feet start sweating. And less friction means the fabric on the heel of your boots won't wear out as quickly. Fleece is the warmest thing to wear if getting wet is unavoidable (as in tropical climates) and it is great to sleep in.

Socks are the only exception to the no-cotton rule when one is in the desert, as long as you bring plenty of them — at least one pair for every day.

Wear a nylon windbreaker for trips that take you to subalpine zones; one- or two-ply is enough for all but the most frigid conditions. A little wind should be able to get through it. The idea is to have something that will function well on a rugged hike while still letting you stop for small periods of physical inactivity to examine potential specimens without getting too cold. Deserts are windy too, but hot enough during the day to negate the need for a windbreaker.

FOOD

The best food is enjoyable, but low-maintenance enough to let you spend most of the time rockhounding. Packs of instant oatmeal only require hot water, as do instant cocoa and coffee. (Regular coffee filtered through a bandanna works for those who hate instant.) Granola bars, Pop-Tarts, trail mix, carob chips, and dry cereal are full of carbohydrates to get you up and over any hill and sustain the most rigorous rockhounding activities.

Unless you're on the thin side of your weight, 2,500 calories a day — mostly from carbohydrates, since they burn readily — will do fine for multi-day expeditions. Commercially prepared dehydrated food is low bulk, lightweight, and packed with a balance of carbohydrates and vitamins. But prices range from $10 to $18 per thousand calories. On the other hand, several boxes of mac-n-cheese poured into a large Ziploc bag coupled with a daily vitamin have the same benefits, minus the taste.

If you're camping close to the parking lot, there's no need to buy lightweight dehydrated foodstuffs because you won't have to hike it in very far. However, bears have been known to vandalize cars for their food content. When in bear country, hike food in last

Backpacks made for rock climbers are great for day trips; they'll hold a small amount of gear, plus specimens.

Make sure the clothing you pack and wear is appropriate to the season and climate. Layer warmer clothing over cooler and discard or add layers as necessary.

to avoid leaving it unattended and in the open and store it in an approved food locker or bear-proof container.

BACKPACK

Backpacks with external aluminum frames are comfortable and easy to balance when loaded top-heavy. The only problem is that when you set up camp and set out collecting, all of your gear is going to be back at the campsite, leaving the backpack empty. Internal frame packs function best when loaded bottom-heavy, which is a good fix for this scenario.

Whatever style of pack you ultimately choose to go with, it should have sufficient volume to carry your camping gear and field equipment *plus* room for samples collected. Resist the urge to fill it to capacity before heading out.

Lining the inside of your backpack with an appropriate-sized trash bag will help keep it dry. Another one over the top of the pack, with holes torn for the straps, works as a pack cover. I pack my sleeping bag in one, too, instead of the factory-made sack.

Pack as much as you can in the outside pockets. The rock hammer can be fastened on the outside of the pack, upside down, to prevent its head from hitting yourself if you fall. Chisels fit nicely in the side pockets and are more accessible there. Your loupe can go in the other side pocket after being wrapped in a bandanna. Pad sensitive equipment by wrapping it in clothes or a sleeping bag. Efficient packing will save you from having to unload the bulk of your gear every time you want to stop and reach a piece of equipment.

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Researching the geology of the collecting site will tell you whether to bring rock-breaking tools or digging tools.

TOOLS

Tools can easily be the heaviest equipment you'll carry. If you're expecting to break rock, sledgehammers, chisels, pry bars, and steel wedges will add poundage to your pack, so consider your other equipment carefully. Shovels, screens and gold pans are bulky and can be hard to carry, and will hamper you on steep climbs. Large, heavy equipment such as sluice boxes and vacuum units for gold collecting may dictate that you hunt specimens not far from your parking area.

Small tools like screwdrivers, tweezers, and glass vials for gold flakes can be easily lost. Ziploc bags keep small items together and allow you to see what's stored in them.

Equally as important as tools for removing mineral specimens are packing materials for transporting fragile specimens safely. Toilet tissue serves a dual purpose and is lighter than newspaper. If you expect to collect more than your pack will hold, folding cardboard boxes can be collapsed for the trek to the mining site, then unfolded for packing, but are less convenient to carry out.

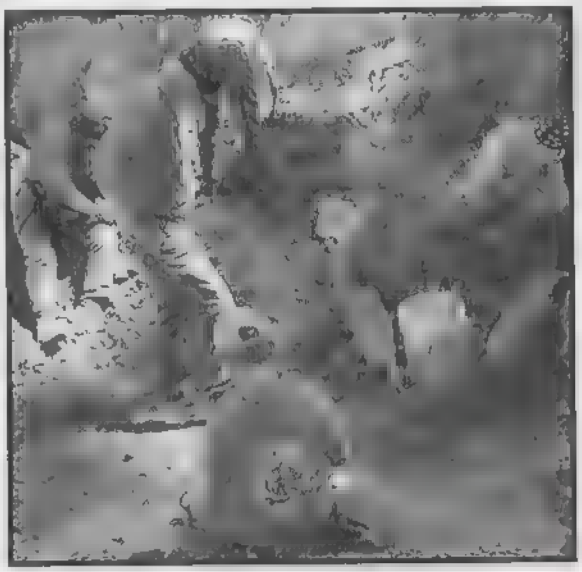
SMALL ITEMS

Some kinds of safety glasses have flip-down sunshades, and that fills a double need for desert and subalpine field trips. Bring an extra pair of sunshades just in case; sun reflected off sand and snow can cause temporary blindness by sun burning retinas. Standard safety glasses (stowed in terrycloth or a case) will suffice in tropical areas.

Acid carried in a plastic bottle can be buffered from pressure by packing it with extra newspaper or toilet paper, which can also be used to pack fragile specimens for the trip home. A headlamp with a red LED will reflect off nearby crystals and other glossy materials at night. A small survival kit the size of a sardine can, available at almost any Wal-Mart or K-Mart, is a good investment and weighs a quarter of a pound. It contains a button compass, a pack of waterproof matches, and other items that are good to have.

MAP

Apart from a geological map, a detailed topographical is invaluable because it shows many of the lesser-known trails in a given area. Get one that's durable (some are made of paper-thin plastic; detailed 15-minute maps are a great size for field trips), and current (trails are often amended or rerouted). Then trace your intended route on it and copy or fax it to a trustworthy person so someone will know where you are in case of emergency. Most maps are also available as software. Make paper maps water-resistant by laminating them with one of the cheap kits sold at a department store.



Having the right gear means you can concentrate on collecting instead of worrying about what the weather will throw at you.

WATER PURIFICATION

Waterborne parasite infections (Giardia and Cryptosporidium) are more common in populated areas of the back country where there are other people to spread it. Bring water from home if you'll be within a couple miles of the car. If not, there are some options for minimizing your chances of being infected.

Chemical purification tablets are available at Wal-Mart, Army Navy and hunting stores, and just about any shop that has a camping section. They're supposed to work, but I've had more than one friend get a Giardia infection while using them religiously. The majority of intestinal bacteria infections are passed by dirty hands, so the tablets are best used to purify water used for washing dishes and hands.

Water pump purifiers, if they don't clog when you need them most, are subject to freezing with overnight temperatures. The benefit of using one is that it also removes water scum and small granules, which no other method of water purification can do. Their effectiveness at removing waterborne parasites has come a long way since they were first introduced. Many experienced people think water pump purifiers are worth their weight (1 pound). Bring an extra filter, just in case.

Boiling water is my favorite method of purifying because it's the only foolproof way to kill waterborne parasites. It won't remove insoluble pollutants or particles like a pump purifier will, and the extra fuel required (a half-pint per day) is heavier than any other method. It also requires unpacking the stove, but it works.

STOVE

The fastest and most convenient stove to use is one that runs on a vapor cartridge. It's also the most clean running and spark-free, a plus if you're venturing into the desert. If you plan to stop to make tea every half mile, tote an extra cartridge into camp.

Denatured alcohol stoves are the most lightweight by a long shot, but worthless in windy subalpine conditions; the flame isn't as hot or pressurized as that of butane or white gas stoves. Liquid fuel (white gas) and multi-talented models that burn auto gas) stoves are the cheapest to operate after buying them. These are also the hottest and they are practical for all conditions. The downside is that liquid-fuel stoves are the heaviest and often have only two settings: off and full blast. In my experience, white gas stoves go best with things that require only boiling water to prepare.

SHELTER

An extra canopy or large tarp will keep unwanted rocks out of your tent. When you're camping close to the car, you can store specimens on and under a cheap folding table. Empty milk crates will keep everything organized underneath. For camps farther from the car, a 12-foot by 12-foot tarp will serve as both a workspace and convenient place to sleep in all but the windiest weather. In wind, a tent with room for only yourself will do as well as a mountaineering tent, and a paraffin candle placed inside a cooking pot will heat the shelter adequately.

SLEEPING ARRANGEMENTS

A self-inflating Therma-Rest mattress is the most comfortable, but bulky and heavy. I prefer a closed-cell foam pad any day. Down is great fluffier for a sleeping bag because it's the warmest thing for the weight, and a 45-degree bag will compress down to practically nothing. Down is a space saver, with synthetic fill close behind.

Gore-Tex or other weatherproofing material (they don't use Gore-Tex much in newer sleeping bags) will make your bag virtually storm-proof, but I've learned that weatherproofing should

come from a shelter instead of a sleeping bag if you want to keep the weight down. Gore Tex sleeping bags can still be bought from specialized outfitters and on eBay.

If bugs are a potential problem in your destination area, you can bring repellent (DEET or Citronella), wear a head net or start a smoky fire. In any case, sleep in a tent with no-see-um netting.

DAY-TRIPPERS

The same gear minus the shelter, stove or sleeping gear can be used when you're only out for the day. After packing the essentials—eyepiece, safety glasses, hammer and chisels—add a poncho, cigarette lighter, foil blanket, a detailed map, and a small compass. A poncho will block the wind even when it isn't raining. Foil blankets actually do retain warmth, and a lighter is just plain good to have. A map and compass are necessary when I get off the trail and start following intuition. These five items together weigh only a couple pounds, but if you ever need them, they're handy.

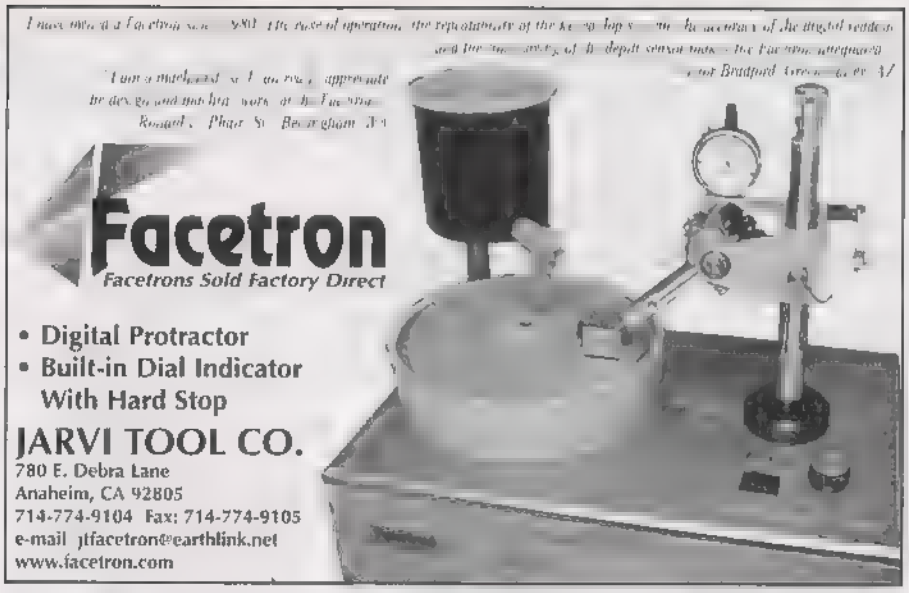
Backpacks made for rock climbers are great for day trips. Climbers carry tools similar to those that rockhounds carry, so stowing equipment like hammers or chisels is a snap. They're the perfect size for packing a small amount of gear, plus specimens. But they are pricey.

SPECIAL CONSIDERATIONS FOR PANNERS

Since it's a given that you'll be in water, wear clothes that dry quickly and retain warmth when wet. Nylon pants can be wrung out and subsequently worn dry. Pants that unzip at the knees can save a lot of hassle. Fleece sweaters retain the most warmth when wet, and wool follows close behind.

Everything below the waist should be nylon. Cotton underwear can soak and cause both heat loss and heat rash. Even silk, though quicker to dry than other materials, will take longer with an outside layer that's wet. Sandals are good for wading instead of getting boots wet. Algae-covered rocks are usually present in slow-moving streams, and are too slippery to walk on barefoot.

Careful attention should be paid to what you bring on your field trip and how it's packed. Having the right equipment can heighten the success of your collecting experience. But don't fret if you don't have everything to spec; determined people can, and do, get away with much less.



The Bookshelf

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Rock Science

by Steve Voynick

Is Cinnabar Hazardous?

Growing concerns about the environmental and public health hazards posed by metallic mercury and its compounds have some collectors wondering whether cinnabar specimens constitute a danger. The answer depends on the circumstances.

Cinnabar is mercuric sulfide (HgS), the most abundant of all mercury-containing minerals. Most collectors can recognize cinnabar's bright-red to brownish-red crystals and incrustations. Cinnabar has a Mohs hardness of 2.0 to 2.5 and a specific gravity of 8.0 to 8.5, and crystallizes in the rhombohedral system as thick tabular, columnar or prismatic crystals. As an epithermal (low-temperature) mineral, it forms in shallow hydrothermal veins in areas of volcanic and hot springs activity.

As the only important ore of mercury, cinnabar has been mined since antiquity, initially for use as a red pigment and later as a source of metallic mercury. Mercury, the only metal that is liquid at room temperature (70 degrees F), has a silver or tin-white color, a tendency to form globular droplets, and a high specific gravity of 13.6, making it dense enough to float such metals as iron and silver.

Until the improved cyanidation processes of the early 20th century, amalgamation was the only truly efficient nonsmelting method of separating metallic gold from its ores. Later, metallic mercury found widely varying uses in everything from thermometers and barometers to fluorescent-light tubes, vapor lamps, batteries, and dental amalgams.

Although the toxicity of mercury and its compounds has been known for centuries, researchers are only now determining the true extent of that toxicity. When ingested, absorbed or inhaled in sufficient quantities, mercury and its vapors and compounds adversely affect the nervous system, brain, kidneys, and embryonic and fetal development. Tales are legion of physical and mental debilitation and even death among mercury miners and mill hands and others exposed to the metal and its compounds in industrial and manufacturing operations.

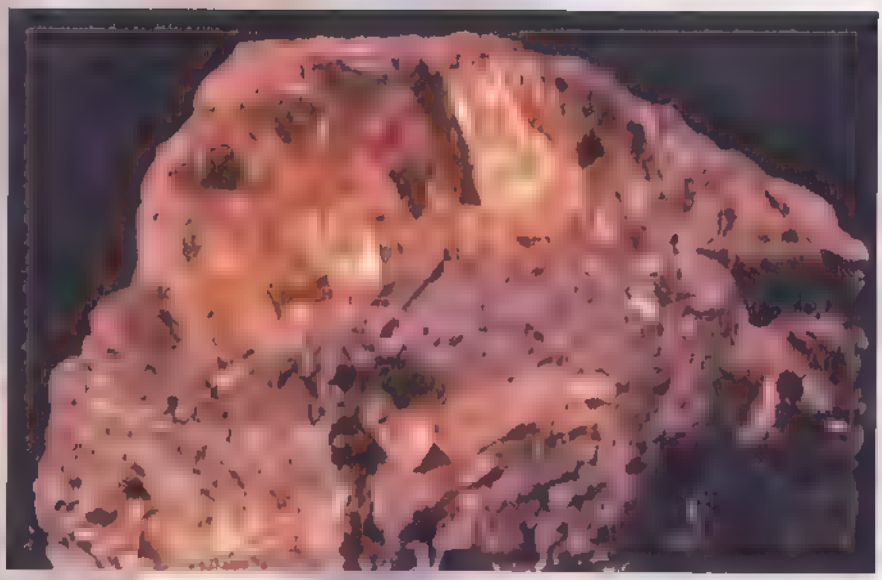
But the specific toxicity of mercury and its compounds varies greatly. All mercury compounds, including cinnabar, are considered hazardous. But because mercury forms strong bonds with sulfur, cinnabar by itself is not a major threat to human health. Metallic mercury is also a less hazardous form of the element. If ingested in small quantities, liquid mercury often passes through the digestive system with no ill effects. Of course, continued exposure to cinnabar or to metallic mercury, as in a mining or milling environment, sharply elevates the health risk.

But mercury vapors are extremely toxic. Other compounds of mercury, especially organic compounds such as ethyl mercury and methyl mercury, are also highly toxic. Unfortunately, reactions with acids and natural organic compounds can convert metallic mercury and cinnabar into these soluble, highly toxic forms. These reactions can occur in soil-type environments such as those found in surface heaps of mine or mill wastes. Eventually, these organic-mercury compounds will reach lakes and oceans, where they are ingested by lacustrine and marine life, to be carried up the food chain and eventually concentrated in predators, including large fish that are an important source of human food.

Reactions with metallic mercury and cinnabar, however, are not the primary cause of global mercury pollution. This is attributed to coal-fired power plants worldwide that burn massive amounts of coal, most of which contains trace amounts of mercury. Although this type of mercury pollution is initially atmospheric, precipitation carries the mercury into the oceans where it is converted to harmful organic forms that enter the food chain.

So the answer to the question of whether cinnabar constitutes a health hazard is both yes and no. In soil-type environments, cinnabar can indeed convert to highly toxic organic mercury compounds. But as properly stored mineral specimens, cinnabar is not a significant health hazard. Atmospheric oxygen can sometimes chemically reduce small amounts of cinnabar to metallic mercury, which appears as tiny, silvery globules in the cracks or on the surface of cinnabar specimens. Such small amounts enhance the interest and appeal of cinnabar specimens, but are rarely enough to constitute a mercury-vapor hazard.

Nevertheless, after handling cinnabar specimens, a bit of precautionary hand washing is never a bad idea.



Fine yellow gem labradorite, some of it still in matrix, can be collected from the site of a remote volcanic occurrence in Chihuahua, Mexico

The most common member of the group is albite, which is frequently found in gem pegmatites. This sodium aluminum silicate is a major constituent of many pegmatites, in which crystals of sometimes amazing size are found. The crystals can have a flattened appearance, can be tabular, platy, bladed, massive, and even thin lamellar crystals tightly packed. One important role albite plays is to provide a platform upon which more important gem crystals are superimposed. The reverse is also true, as albite decorates previously formed gem crystals, like the tourmalines.

Albite forms fairly early in a pegmatite, so it is not unusual to see a wonderful beryl like aquamarine or one of the colorful tourmaline group, particularly elbaite, perched on a curving mass of bladed white albite, or even decorated with small white plates of albite protruding from the gem crystal's prism faces. When the albite blades are thin and platy, seeming to be in nearly parallel clusters in a pegmatite deposit, they are called cleavelandite.

When the albite blades in a pegmatite deposit are thin and platy, and seemingly in nearly parallel clusters, they are called cleavelandite.

The great bulk of this feldspar mineral makes up the white groundmass of a pegmatite body. Graphic granite, always associated with pegmatite deposits, is largely massive albite with small quartz bars and angular crystalline quartz locked in it, making it look like some form of cuneiform writing.

Twinning in albite is very common, particularly in the variety pericline. Albite in discrete crystals will show Carlsbad, Baveno and Manebach twinning, just like the orthoclase feldspars. It is most often white, but can be slightly tinted, as seen in the pink to red granites of the Pike's Peak region. Rhyolite, a slow-flowing volcanic rock is very low in quartz and is composed mainly of albite feldspar. This is also true of other rocks such as andesite, syenite, and metamorphic gneisses and schists are largely altered granites. It's also found in limestone marble.

One of the most interesting habits of albite, and one that makes it quite highly prized, is its ability to develop in lamellar form. When its platy habit shows up internally, the results can be exceptionally attractive, as it affects the light entering the specimen. The thin albite plates stack in parallel, like sheets of paper, and this causes light to be scattered, giving the specimen an opalescent appearance. When properly oriented and cut, it shows a very attractive schiller effect, usually a moonstone blue.

Of all the members of this plagioclase group, albite is the most important and the most common. Many of the localities in which it is found are classic pegmatite deposits in Brazil. Some of the largest platy albite crystals mined came from the Italiaia Mine in the form of cleavelandite. Of particular interest are the albite casts after spodumene from the Corrego do Urumun. If you visit the wonderful Gem and Mineral Hall in the Smithsonian, you'll see a couple of amazing red elbaite crystal clusters, with each crystal tipped by blue terminations. These are the famous blue cap tourmalines from the Tourmaline Queen Mine. These specimens are so well known they have special names, the Candelabra, a group of three free-standing elbaites, is the most important. These lovely gem crystals are made even more attractive by the wide skirt of albite upon which they rest.

Plenty of localities other than pegmatites produce nice albites. The old epidote locality at Untersalzbachtal, Austria, yielded small, white, discrete albites on byssolite. Some of the largest platy albite crystals ever found came from the Silver Crater Mine near Bancroft, Ontario. Measuring upwards of 10 inches, these are exceptional even for this common feldspar.

Orthoclase is normally a pegmatite mineral, but also occurs in other type deposits where it will often form simultaneously with albite. When these two form as alternating thin, platy crystals, they create a diffractionlike grid that produces a schiller effect. This variety of chatoyant feldspar is called peristerite, a gem variety of albite. It may be the albite-orthoclase mix or just albite. The resulting schiller effect may exhibit a bluish or even a golden color.

Peristerite has been called pigeon stone for reasons I know not. It can be cream colored or pale brown, even tending toward a brownish pink. What makes this a very attractive stone is its schiller. The finest peristerite is from Mountaingle, Ontario. It shows a lovely celestial blue flash. Other sources of peristerite are in Quebec and a more recent find in Kenya.

From my own experience, any time you are collecting in a pegmatite deposit, keep an eye out for peristerite, on several occasions, I've gathered orthoclase showing the typical subtle striations of lamellar crystals. These may show a weak to good schiller effect and deserve further attention. Since albite and orthoclase both tend to form lamellar platy structures in the right conditions, you can often find large pieces of feldspar with schiller due to interference with light by the lamellar crystals.

continued on next page

While most collectors do not seek to collect albite itself, many collections have fine albite crystals in them. These specimens are not collected because of the albite, but because of what it brings with it. Albite, in the form of cleavelandite, is the most common accessory mineral in pegmatite gem pockets, so it is the companion of many valuable and showy crystals of gem morganite, aquamarine, elbaite, liddicoatite, heliodor, and the like. It can host fine garnet gems, particularly spessartine. Many of the uncommon to rare pegmatite minerals are also found on and with bladed albite. This would include brazilianite, chrysoberyl, columbite-tantalite, and such other species collectors find attractive. While most collectors pay little attention to the albite, there is no doubt that the white platy mineral adds a measure of beauty to many specimens.

Lately, an abundance of gem pegmatite minerals has come from Pakistan and Afghanistan. It's hard to believe that these deposits remained unknown to the outside world until the 1970s. At that time, the Russian government sent teams of surveyors and geologists into the mountains of these countries, ostensibly to seek gem deposits. (That they also mapped the area carefully and invaded Afghanistan later is simply coincidence.)

The geologists were thrilled to find, among the rock rubble on the mountain slopes, choice kunzites, elbaites, beryls, and other typical pegmatite minerals, which had been released from the host pegmatites by weathering. Of course, this prompted efforts to collect and mining of pegmatite pockets soon commenced. Marvelous aquamarines, fine tourmalines, peach-colored morganites, some of the world's finest large kunzites, and other specimens have come to light in the last several decades. Perhaps the most exciting specimens I've seen are the foot-long violet kunzites on matrix, part of which is albite!

Gem mining in Pakistan and Afghanistan has become quite sophisticated. When the float crystals were first found, they were collected in burlap bags and dragged down the mountains. You can guess what they looked like when they reached the market. Today, when a pegmatite pocket is opened with crystals in situ, a diamond saw is used to remove the entire pocket intact. This virtually eliminates damage to the crystals and keeps them on the matrix, making them more desirable to collectors. The blocks are cut down to size and the sawn surfaces are worked on to make them look like broken rock. If you have attended the Tucson Show, the Munich Show, the Denver Show, or other major shows with special exhibits, you have undoubtedly seen large, breathtaking pegmatite rocks of graphic granite with choice kunzite, aquamarine, or other beryls in perfect condition and of impressive size. Such specimens sell for tens of thousands of dollars.

The gem regions of these mountainous countries are now visited by a number of mineral dealers from all over the world. The local miners have, as a result, realized the value of their efforts. From visiting shows and selling minerals, the local miners also have a good idea of what the market will bear when they offer minerals to visiting dealers. That, in turn, makes it tough for the Frugal Collector to get a nice example of Afghanistan or Pakistan pegmatite minerals.

This unusual specimen is albite that has taken the hexagonal shape

I would suggest the Frugal Collector watch for the nice dark-green elbaites with pink terminations, usually 2 inches or so long, from Stak Nala, Pakistan. These are often heavily skirted with platy cleavelandite and make very showy specimens that are relatively inexpensive because they came out in such huge quantities.

While albite is a sodium aluminum silicate, anorthite is a calcium aluminum silicate. In fact, these two feldspars form a complete series, with the sodium and calcium substituting for each other, and this, in turn, is what creates other species of the group.

Starting with pure sodium aluminum silicate (albite), calcium can gradually begin to replace the sodium, and the species oligoclase forms, with sodium still dominating. As the calcium and sodium approach a balance, the next member of the series, andesine, forms. Next comes labradorite, wherein the calcium content exceeds the sodium content. This is followed by bytownite, rich in calcium, with anorthite forming the pure calcium end of the series. You can see how identifying the members of this group can be a challenge, since there is no obvious physical way a collector can judge the level of calcium vs. sodium in a particular specimen. This is why it's so important to recognize the minor differences in physical features and, more importantly, the mode of occurrence of these feldspars.

Anorthite tends to form at higher temperatures than albite. It is frequently found as a rock-forming mineral in basic plutonic rocks and volcanics. It is rather difficult for the species to form discrete crystals when it is trapped in a molten flow, so it is seldom seen as collectible crystals.

One of the premier rock varieties containing anorthite, in my opinion, is called norite. There's nothing special about norite as rocks go, but in Southern California it takes on a special role for gem collectors. Norite is the gray, fine-grained rock that extends through much of the Mesa Grande and Pala-Fallbrook areas of Southern California. These place names should alert the reader that the norite does something special. The nondescript norite plays host to some of the most productive pegmatite veins and pockets in this country.

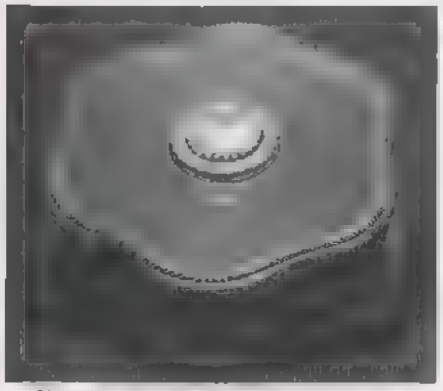
A prime example is the productive pegmatite called the Himalaya Mine of Mesa Grande. The white pegmatite vein contrasts sharply with the gray host rock. According to theory, as the pegmatite solutions forced their way into the norite, chunks of the gray host rock fell into the solutions. This created turbulence in the flowing solution, making crystal pockets more likely to form. During mining, these chunks of gray norite, called horses, signaled that pockets were nearby.

The pockets in this pegmatite have yielded literally hundreds of fine gem elbaites, rare tantalite, superb quartzes, cassiterite, and even some zeolite crystals. The deposit extends for hundreds of feet, actually showing up on both sides of the mountain.

I was invited to dig at the Himalaya Mine several years ago, when pegmatite gem-bearing pockets were being encountered regularly. The owners had promised to call me when a gem pocket was hit. I received that welcome call during Christmas vacation, so my son Evan and I dashed over to Fallbrook to rendezvous with our host, Bill Larson. We were escorted underground into a tunnel that followed the pegmatite vein through the contrasting norite. Evidence of previously found pockets was obvious. Sure enough, we came to an exposed pocket of quartz and decom

posing feldspar, mainly albite. Sticking out of the white to yellow feldspar clay were the ends of fat, colorful elbaite crystals. The crystals were no longer attached to the pocket walls where they had formed. Some scientists think pegmatite pockets often rupture, and this shatters the gem crystals from their pocket walls, even breaking some of them into sections. At times, you will find one portion of a crystal on the opposite side of a gem pocket from the rest of the crystal.

Evan did most of the digging that day. He was joined by Ralph Potter, now deceased, but at the time one of the owners of the property. Ralph's reputation as a pegmatite miner in that area is



Moonstone, forming the button on this silver Fabergé bell push, has a variety of decorative uses.

unrivaled even today. The end result of the digging was a couple of 5-gallon buckets filled with elbaite crystals and crystal sections. Some were attached to quartz. Other elbaites had platy albite attached. It was quite a day!

The classic source for discrete anorthite crystals, usually well under an inch, is in the volcanics of Mount Vesuvius, hardly an exciting collector source for minerals.

Andesine suffers the same fate as other feldspars, for it is usually massive, forming the main ingredient in andesite, one of the more explosive volcanic rocks. Some crystals do occur in small tabular form. These develop as triclinic crystals. The first triclinic tabular andesines were found in the Andes Mountains, after which the mineral is named.

Certainly, one of the more exciting members of the plagioclase group is the gray-blue feldspar rock labradorite, named for the Canadian province Labrador, in which it was first found. Though it occurs largely as a rock-forming mineral, it can also be found as a wonderfully attractive transparent gem, suitable for faceting.

All massive labradorite is opaque, ranging from light to dark gray in color. There are two reasons for this. The gray color is thought to be due to microscopic platy inclusions of magnetite. While the labradorite crystals themselves create most of the color due to their interference with light, the platy magnetite adds to that rainbow of colors. When the iron oxide inclusions are hematite, a slightly different effect is seen. Resembling aventurine quartz, labradorite with hematite inclusions can be referred to as aventurine labradorite.

Labradorite makes a wonderful decorative stone, since it shows a bright multicolored schiller effect commonly called labradorescence. This is due to the lamellar development of the internal crystals, which can scatter light to create a rainbow of colors.

The rock occurs in a number of localities that are still open to collectors. My introduction to collecting superb labradorite happened on a trip up through upstate New York to Canada. My eye was attracted to a splash of rainbow color coming from rocks and boulders along the side of the newly built Interstate 87, not far from the famous garnet locality, Mount Gore. I stopped to check out the source of this colorful display. It turned out that all the boulders on the sloping shoulders of the new highway were labradorite. They were later buried so grass and plants could be installed. Though I've never been back there, I have to believe there is still an abundance of fine gray-blue labradorite rock in the vicinity of that highway.

Fine cutting-grade labradorite is also found in the Russian Urals, while Greenland, Norway and Finland also yield superb examples. While traveling in Russia to work on the video "Russian Gem Treasures," I saw a number of fine masses of labradorite on display in the country's major institutions. But the surprise of the trip was the labradorite I saw on the grounds of the Kremlin.

We enjoyed the treasures inside the Kremlin, but the real surprise was the huge curbing blocks used as borders for the immense flowerbeds on the Kremlin grounds. They were different types of decorative stone, including marble and very fine dark gray-and-white jasper. The most impressive retaining wall was made of huge blocks of labradorite, each weighing hundreds of pounds. The square-cut, polished blocks measured about 3 feet long, 2 feet high and about 1 foot thick—approximately 200 running feet. If I had had a hammer, I might have ended up in the gulag!

continued on next page

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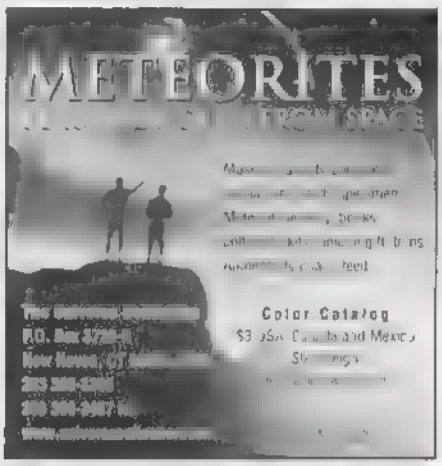

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The Feldspar Group *from page 75*

On later visits to some of the palaces and state buildings in St. Petersburg, we saw more decorative objects made from labradorite. I can only imagine what the Uralian mountain deposit must look like!

What gives massive labradorite its schiller, or labradorescent colors, is called an interference effect at thin films. As platy crystals of labradorite form randomly, the rock hardens. These labradorite crystals lie at various angles within the rock mass. As light enters the surface of the rock it strikes those randomly arranged crystals at various angles, and each scatters the light so that a bright, fiery color or several colors, may be reflected back to the viewer's eye. As you rotate the polished surface of the labradorite, the various angles of reflection create a panoply of color, which varies because of the thickness and angular position of the plates themselves. Since most of the crystals are close to the same size, you see mainly one color, blue. But you might see green, red, bronze, yellow, and violet to varying degrees. The result is a vibrantly colorful decorative rock, which can even be cut en cabochon and used in jewelry.

Another form of labradorite that is better suited to jewelry is the golden yellow material from a remote volcanic occurrence in Chihuahua, Mexico. I was fortunate to be escorted to this deposit by the man who discovered it, Benny Fenn, one of this country's important dealers in Mexican minerals.

The deposit is a volcanic flow, probably basalt, that is fairly thin as lava flows go. It measures a few feet thick, which may explain why the phenocrysts of labradorite might have formed as the lava cooled. The yellow labradorite crystal fragments measured from a fraction of an inch to as much as 2 inches across, they were completely gemmy and clear with a nice straw yellow color. Crystals were so abundant that hammering and digging were not necessary, we simply picked up the loose crystals released by prolonged weathering of the deposit. A couple of hours of selective picking filled a bag with gem rough. These gems were originally thought to be bytownite and were sold as such, but testing showed them to be labradorite.

Labradorite phenocrysts in basalt and other lavas are not rare. The noted collector site at Rabbit Hill, Oregon, yielded what are called sunstones, yellow to red gems of labradorite. Sun's one's the state gemstone of Oregon because of several occurrences of the very colorful collectible feldspar gem.

Oregon is particularly rich in sunstones though it is not the only source. What make the Oregon sunstones unique are their exceptional color varieties and the cause of their varied colors. The colors range from yellow to red to green, and can even show a rare alexandrite effect. Microscopic bits of native copper scattered throughout the feldspar give the gems their unusual color. The largest stones found in the area can yield gems weighing several dozen carats.

The average rockhound can collect sunstone in Oregon on a state-owned section around Rabbit Hill. The place has been heavily collected, but digging only with hand tools is allowed. Nothing of a mechanical nature is allowed, and explosives are verboten!

One small group of feldspars deserves some mention simply because it is based on yet another metallic element cation, barium. Celsian and its paramorph paracelsian seldom develop as nice crystals. These barium aluminum silicates are only rarely found as small, sharp monoclinic crystals. They occur along the contact zones of manganese and sometimes barium deposits, but you'd be hard pressed to find one for sale.

The mineral hyalophane, a potassium, barium, aluminum silicate does form the occasional water-clear prismatic crystal. They are quite small and come from the classic mineral source at Binnental, Switzerland. This deposit is an interesting metamorphosed marble limestone, which has yielded a considerable variety of rare and unusual minerals. The Swiss hyalophane crystals are usually colorless, but can be lightly tinted yellow.

The only source of interest to most collectors is the now closed Franklin-Sterling Hill, New Jersey, region. Hyalophane occurs there as large, crudely formed phenocrysts in matrix. They are only of interest in identifying any specimen collected. Much more common at Franklin and Sterling Hill are solid masses and even some crystals of microcline, a potassium feldspar.

While the two parts of this article series do not cover all members of the group, those that are important as collector minerals or important as accessory minerals have been introduced. The Frugal Collector would do well to collect and study these group members, for they provide good examples of the monoclinic and triclinic crystal systems in which they form. Most feldspars are relatively inexpensive and, in some cases, readily collectible.

THE MINES OF BINGHAM, NEW MEXICO

A Famous Mining District Offers Collecting Opportunities

Story by Lori Lamb

The summer of 2002 meant a serious lack of rain for New Mexico. The Rio Grande River was actually dry for several miles in some regions. It also meant forest fires, large and widespread. For our family, summer 2002 was our planned trip to some of the most famous mining districts in New Mexico: Socorro, Bingham and Magdalena. Planning for the trip had begun the previous winter. In January 2002 I contacted Alanson Nilson of the Blanchard Rock Shop (505.423-3235) in Bingham, New Mexico. She owns some of the mining claims in the district and can secure access for others to dig for a prearranged fee: substantial, but absolutely worth it. We made plans to visit the Mex-Tex and the Royal Flush and other sites to be arranged upon our arrival.

The Royal Flush and Mex-Tex are two of several mines of the Hansonburg Mining District, located in the central region of New Mexico. The district lies in the Rio Grande Rift, a major break in the Earth's crust that runs north to south across the center of New Mexico and down into Chihuahua, Mexico. Along the borders of the rift are numerous mountain ranges, some rich in mineralization. Geologically speaking, the rift and its bordering ranges were caused by tension from the pulling apart of the Earth's crust in this area. The tensions established a pattern of tilted mountain ranges, which hosted volcanism from mid-Tertiary times. One of these ranges, the Sierra Oscura Mountains, occupies the southeast corner of Socorro County, and provides the infrastructure for the mines. Over time the sharp ridge of Precambrian and Pennsylvanian rock found along the western fault of the Sierra Oscura has been fractured and intruded by magmas, allowing for the mineralization that occurs in veins in this region.

DARYL LAMB

Blue linarite, green brochantite, white barite, and metallic silver galena cubes combine in a colorful specimen from the Mex-Tex Mine.

Though geologically attractive, mining in this region has been sporadic through the years. This is, in part, due to the geographic location of the deposits, located on the eastern border of the Jornada del Muerto. The early Spanish explorers and would-be settlers in the Southwest named this expanse of land around the Rio Grande Rift the Jornada del Muerto because it was a broad valley with a serious lack of available water. Punishing temperatures of over the 100 degrees, lack of shade, and miles of barrenness claimed the lives of many who tried arrogantly to

traverse it. These conditions dissuaded substantial mining for years. Even today, much of the Jornada del Muerto is still desolate, though for a different reason: it is now the home of the White Sands Missile Range administered by the U.S. military. Still an active missile range, much of White Sands is restricted access. This proximity to a restricted-access area makes the use of a guide worthwhile to prevent unintentional trespassing on restricted land.

Even though remoteness and lack of water deterred large-scale mining, the region still has a reasonable mining history. Prospecting began in the 1870s with a copper discovery, followed by an interest in lead. The primary lode ore for lead was galena, found in cubes in a fluorite-barite gangue. The copper lode ore was in the form of chalcopyrite and some tetrahedrite. Some barite mining has also occurred. In the 1950s, the Mex-Tex was actively mined for barite, producing some 37,000 tons of grade material. The antagonistic relationship between commercial miners and high-grade collectors led to uncomfortable, sometimes even dangerous encounters in the 1960s and 1970s. However, in the mid-1980s, the economy rendered the commercial mining unprofitable, so the claims lapsed and were resumed by individuals focused on a different treasure: the beautiful and sometimes unique mineral specimens previously secondary to, or even ignored by, the mining interests.

As a result of the flow of these specimens into the mineral market, certain minerals have become almost singularly associated with the district. These include the sky blue fluorite from the Royal Flush Mine and the electric blue fluorite and rich green brochantite from the Mex-Tex Mine. Now the miners of the Hansonburg district search out their treasures carefully, cradling each one in newspaper to preserve every crystal face. Thanks to the claim owners, who blast and excavate regularly, the sites remain fresh. It was this access that was attractive to us as we headed west to New Mexico from our North Carolina home.

After a four-day ride, we arrived in Socorro, New Mexico. This would serve as our base, with very reasonable accommodations. We were anxious to begin collecting, but first we had to do our local homework. When heading to a new region and collecting experience, we try to research the possible finds in advance so that our eyes can be more quickly trained to what we seek. To that end, a visit to the Mineral Museum of the New Mexico Bureau of Mines and Mineral Resources was in order. Located in Socorro on the campus of The New Mexico Institute of Mining and Technology, the museum is a must for both the first-time New Mexico collector and the seasoned aficionado. The museum is well designed, with numerous sections, including U.S. minerals, paleontological exhibits, and a superb Dana reference section. But by far the most useful are the displays devoted to New Mexico minerals. Entire cabinets house specimens from area mines, including the Mex-Tex, the Royal Flush, the Sunshines 1-6, the Blanchard, the Kelly, the Graphic, and the Nitt. The museum also has a small number of reference specimens for sale. And, even though we visited on a weekend, museum curator Dr. Virgil Lueth was present and enthusiastically shared collecting tips with us. The museum remains one of my favorites, and is an educational asset to the area. We actually visited a second time after collecting to confirm some of our finds.

LORI LAMB

When larger specimens were cracked with the hand sledge, crystals of blue-green spangolite were found among the white barite and quartz.

DARYL LAMB

Specimens from the Royal Flush Mine have an abundance of anglesite-covered galena, as well as purple and blue fluorite cubes.

DARYL LAMB

Green needles of brochantite are in abundance at the Mex-Tex, though the mineral is scarce worldwide.

Most of the mines and collecting sites in the district are located away from Socorro proper, in various directions. The Graphic, Nitt and Kelly (famous for its bubbly light-green smithsonite) are located west of Socorro off U.S. Highway 60 around Magdalena. Our destination, known collectively as the Blanchard Mines, was located about 45 minutes southeast of Socorro on U.S. Highway 380 at Bingham, a tiny settlement of about five houses. Allison runs the Blanchard Rock Shop here, and owns some of the Blanchard claims. The shop boasts a vast array of beautiful specimens from local sites, as well as some exceptional agates and jades from other locales. There are even a few select pieces of trinitite for sale. Trinitite is sand that was fused into glass by the heat of the nuclear bomb tested at the Trinity Site. This is a unique item, soon to be played out, as it is associated with a single event that occurred over 50 years ago and the collecting area is now strictly off limits.

We secured access to the mines with Allison and coordinated our plans with Wayne Holland, a very knowledgeable guide. In the morning, before the heat of the day, we were to visit the Mex-Tex, an outdoor collecting site, and in the afternoon, we had scheduled an underground experience at the Royal Flush. Since it was June and the mines are located on the edge of the Jornada del Muerto, we loaded up the truck with all the necessities: water, ice, lunch, wrapping materials, buckets, picks, sledges, etc. We headed up the bumpy road into the Oscura Mountains, which separate the Tularosa Valley farther east from the Jornada del Muerto. The landscape is arid, with mesquite bushes and chollo cacti in abundance. Though it did not seem as though we were climbing, once we arrived at the mine, the panoramic view testified to our upward trek.

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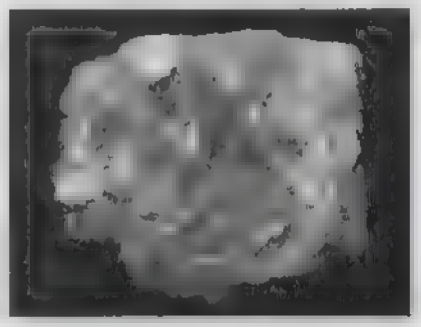
The Mines of Bingham, New Mexico *from page 81*



DARYL LAMB

Pale lavender amethyst, in single points and large pieces covered with points was an unexpected find at the Mex-Tex.

The Mex-Tex is now just a shell of frequently blasted and excavated rich matrix mostly barite, quartz and galena. All underground portals are off limits for safety reasons. We have been to many open pits, mines, and quarries over the years, but what struck me here was the variety of color you could see immediately upon getting out of the truck. Greens, blues, yellows, and purples stood out starkly against the white matrix. These colorful copper minerals and fluorites were secondary minerals from the hydrothermal solutions introduced into cracks in the host rock.

For maximum collecting efficiency, we spread out. Over the course of 10 years of collecting as a family, we have each developed our own style and technique. My son, Chris, scopes out a single location and works it thoroughly, often digging down through tailings for hours. This, of course, also appeals to that desire in every kid to get maximally dirty when the opportunity presents. My husband, the geologist, tends to walk the periphery of the site, examining the underlying geology, the dip and strike of the strata, and then uses his sledge on obscure specimens he finds. I tend to walk all through the site surface collecting, always speculating that better specimens are just a few feet in front of me. Nevertheless, the combination of styles has served us well through the years.

In that tradition, Chris descended upon a freshly excavated mound. His diligence was rewarded quickly with many very nice specimens of linarite, galena pseudomorphs to anglesite, and the only smoky quartz crystals we found the entire day. The Mex-Tex is famous for the electric blue linarite found there. Linarite is a copper lead sulfate, $PbCu(SO_4)(OH)_2$, usually found as small elongated crystals or as crusts. Discovered in Linares, Spain, in 1822, it is a soft mineral (Mohs 2.5) with a pale blue streak. Its bright blue, not as deep as azurites, sets it apart from many secondary minerals found in the oxidation zones of lead mineral deposits. The linarite occurs as small crystals in vugs, as massive sections within the quartz/barite matrix, and even pseudomorphed after galena. The galena pseudomorphs at the Mex-Tex more commonly occur as cubes with a substantial crust of epimorphed anglesite. It took a bit of discernment, but we found a few of these as well. The anglesite coating, also a lead sulfate, replaces the galena down to a small core, but retains the classic cubic shape. Under the stereoscope, it is easy to see the colorless crystals of anglesite gleaming. In addition to the pseudomorphs, Chris also found some nice, solid galena cube floaters.

My surface-grazing technique was also productive. Large pieces of white barite with the classic bladed habit were abundant. I found many with pockets of delicate needles of brochantite sprinkled within. The brilliant green of the brochantite contrasted to almost neon levels against the snow-white barite. Brochantite is a copper sulfate, $CuSO_4(OH)_6$, for which the mine is also renowned. It most frequently occurs as emerald-green needles, best appreciated with the loupe. It is very similar to malachite, with a hardness of Mohs 3.5 to 4 and a pale green streak. The mineral was originally discovered in 1824 in a copper deposit in the Sverdlovskaya Oblast in the Urals region of Russia, and is named after French mineralogist A.J.M. Brochant de Villiers. Though primarily obscure worldwide, it is prolific at the Mex-Tex.

As I took a break and placed my specimens in flats, I noticed that all things green are not necessarily the same green. Some of the specimens contained blue-green aurichalcite instead of, or even in addition to, the grass-green brochantite. Aurichalcite, $(Zn,Cu)_5(CO_3)_2(OH)_6$, is a secondary mineral in copper and zinc deposits. It is silky or pearly in luster and soft (Mohs 2) with a light-blue streak. Like brochantite, aurichalcite was discovered in Russia, but in the Siberian region, in 1839. At the Mex-Tex, it occurs in vugs, between barite blades, or as drusy coatings.

In addition to these blue and green minerals, there was quite a bit of yellow jarosite covering quartz and quartz crystals, though it was primarily in yellow or amber coatings. Jarosite, $KFe_3(SO_4)_2(OH)_6$, is a yellow to brown sulfate, rarely occurring in distinct crystals. Interestingly, the jarosite did not seem to occur on the barite.

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The Mines of Bingham, New Mexico *from page 82*

Though these exotic secondary minerals initially attract the eye at the mine, one should also note the very nice specimens of barite and galena that are found here. Classic white bladed barite is everywhere, often with galena interspersed, making very attractive shelf specimens. And then, of course, there is the fluorite. I found several nice pieces of purple fluorite and some pale green to clear specimens that had bleached in the unrelenting sun. I also found some bright blue linarite, as well as a galena cube completely replaced by linarite, known as a linarite pseudomorph after galena. Thus, my flats were full of six to seven different minerals, many of them excellent display pieces with bright color and classic form.

Meanwhile, my husband had found a different suite of specimens around the upper ledge of the mine. Using his trusted 5 pound hand sledge, he had cracked larger pieces. While these contained brochantite and aurichalcite, they also yielded new fare, the blue spangolite the site is also known for. Best observed with the loupe, the spangolite's teal color is distinct, and that, in conjunction with the stacked-barrel crystal shape, helps in field identification. Spangolite, $Cu_6Al(SO_4)(OH)_{12}Cl \cdot 3H_2O$, was discovered in Globe, Arizona, in 1890 and, like many of its neighboring specimens here, is a sulfate. These specimens, with the varying and intermixed shades of color on the blue to green continuum, made aesthetic cabinet pieces. Finally, another shade of blue caught my eye. Small and delicate powder-blue cyanotrichite "balls" were wedged in some of the smaller cavities of one particular specimen. They looked as though they would float away on the wind like microscopic tumbleweeds. Cyanotrichite, $Cu_4Al_2(SO_4)(OH)_{12} \cdot 2H_2O$, has been found here by collectors in the past. First discovered in Romania, this sulfate has a hardness of Mohs 1 to 2 and a sky blue streak, though I am not sure how one checks that given the delicate nature of the specimens.

By now the sun was approaching noon, though there was a pleasant breeze and we did not feel the 90-plus-degree heat. Before our lunch break, we went a little farther up the hill, 50 yards or so, to an additional excavation for another type of specimen, quartz crystals. The quartz crystals were clear and in plates, short but gemmy. The find here, though, was the pink to lavender amethyst, or rose quartz, as some would tag it. The specimen colors were more pastel than bold, and we found single points that had been blasted free, as well as large pieces covered with the pink points. A bit of washing from a portable water tank helped us distinguish the better pieces. We ended up with three different varieties of quartz: smoky, amethyst, and crystal clear, from this area.

From this high point, the view was spectacular, and we took a break, as lunch was demanding equal time. The expanse of the rift valley below was somewhat intimidating, still primarily unspoiled by civilization. One could easily imagine Indians or early explorers traveling across the valley floor or living along the river in the distance. Interestingly, this daydream was abruptly broken by the sonic boom of the F-18s and other military aircraft conducting maneuvers high overhead, probably out of not so-distant Ft. Hood, Texas.

After very diligently wrapping our specimens from the Mex-Tex, we loaded up and headed out across the terrain for the second half of the adventure, a visit underground to the Royal Flush Mine. Allison extends the opportunity to "work your own pocket" within the mine and keep all that you extract. To make it worthwhile in the limited timeframe, a little prep work is done to speed the process of specimen removal. However, for the extremely experienced miner, virgin territory can be excavated, time-consuming as that may be. Since the visit is underground, though in a horizontal drift, not in a vertical shaft, safety is first and foremost. The entrance stays locked when guests are not present to prevent others from entering the claim unauthorized.

After checking our miner's lamps, loading extra batteries, and dealing with my increasing feelings of pending claustrophobia, we entered the gate and stepped into a fairly large open chamber. The 25-foot-high chamber's walls and ceiling were lined with millions of galena cubes, glittering from our lights. But though impressive and definitely collectable, this was not why we had come. We proceeded into the darkness, carrying buckets and a mucking shovel. The comfortable opening chamber gradually narrowed, and we began climbing until we reached our destination, an area barely 5 feet square, on a shelf well above the floor of the now very narrow and close drift. Our target area had been scouted in advance by our guide to ensure a positive and productive experience.

With our guide's instruction and guidance, we set about cleaning out the layers of gangue rock and "muck" to reach the pocket containing our prize, the blue and purple fluorite that has become a signature specimen of this mine. As the work-

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space was small only my son could fit inside the immediate extraction area with the guide, so he got first crack at the mining experience. I was surprised at how much dust was stirred up in this small area just by the minimal activity of scooping and shoveling debris into buckets. In order to breathe, we had to move very slowly when scooping out the overburden, lest the stirred up dust fill the cavity around us. In addition, great care had to be taken to prevent an errant shovel stroke from "dinging" the underlying crystals still hidden by dust. I quickly realized that being a miner in the early days was not a desirable occupation. The miner's lamps and flashlights did not afford as much light as I would have anticipated either.

The four of us established a bucket line to move the muck out of the pocket and away from the immediate area. It took about an hour to clean down to the actual fluorite crystals. In the relatively low lighting, one could not fully appreciate the color, just the cubic structure. The next phase was to carefully chisel out the pieces. This was exacting work, requiring thought before placing the chisel to maximally preserve the crystals, and complicated by the tight space. But finally we were extracting hand-sized pieces of matrix covered in fluorite crystals. It took yet another couple of hours to clean out the pocket and remove the specimens to the better lighted area outside the mouth of the mine. We were careful not to expose the crystals to direct sunlight, which will bleach the colors over time. Some cursory rinsing of the face revealed excellent pieces with blue fluorite cubes and some deeper purple cubes interspersed with anglesite-covered galena cubes. Most of the samples were composed of densely packed fluorite cubes ¼ to ½ inch on an edge, making fantastic display specimens.

Even though the prize here was the fluorite, I still wanted to be sure to get some of the galena, as well. This was easy since numerous pieces of galena have been tossed aside, unwanted by previous fluorite collectors, on the floor of the mine. I collected several matrix pieces with anglesite-covered galena cubes up to 1 inch on a side. One specimen I picked up had galena cubes covered with a thick, black, leathery looking mineral. This was later identified as plattnerite, a lead oxide previously found at the Royal Flush. Plattnerite, PbO_2, is black with a Mohs hardness of 5.5, typically occurring as a secondary coating on the specimens here. It was originally identified in 1845 in several lead mines in Scotland.

The Mex-Tex Mine tailings are easily accessible once you reach the remote location, and material is abundant

We carefully wrapped each specimen for travel, but did not realize we were not totally finished collecting yet. As always before hitting the road, one must take care of personal business, and on the hike to do so we discovered fossiliferous limestone rich with brachiopods and 2-inch fusulids. Of course, we extracted a plate or two to add to our fossil collection. So finally, after a full seven hours of collecting, we packed up and made the 45-minute drive back to Socorro for rest and refreshment. As the muscle aches emerged, we all moved a bit slower than we had at sunrise. Nevertheless, given the success of the day's experiences, we agreed to return for a second half-day of additional collecting.

Our second day was spent at two small private prospects belonging to Alison. With our schedule fairly full, we were only able to spend limited time at each site. At the first we found more fluorite, galena, and additional brochantite that was nice, but not as spectacular as our previous finds. A closer look by Chris, however, revealed some specimens with very small, paper-thin wulfenite crystals, with the classic caramel-orange color. They seemed to occur in relict casts of galena and in small vugs, and only in the quartz matrix. These were best appreciated with the loupe, though one single was about ¼ inch on side. This site also produced some beautiful aqua aurichalcite on snow-white barite. The contrast made for excellent shelf specimens. The quartz at this site was abundant, much of it with a hematite coating. While most were orange- to yellow-tinted, a few of the crystals had a deep reddish to purple coating, and reminded me of a "bloomin' onion" served by some restaurants. This particular site was harder to get around on, and most of the tailings were far too large to transport. Still, the wulfenite, aurichalcite, and painted quartz made it a worthwhile stop.

The second site, the Desert Rose, was primarily a barite site, but is unique for the blue fluorite tetrahedrons found only at this site in the district. The fluorite tetrahedrons were small, about ⅛ inch, and sandwiched between platy layers of barite in selected seams. In other areas of the mine, there had been recent excavation and the individual blades of barite swelled to slabs 6 to 8 inches wide. These dwarfed the renowned barite from Stoneham, Colorado, in size, but the color was primarily opaque white with a yellow tint. I gathered several of these blades with which to construct a wind chime upon my return home. Their density was surprising for their size, and I had to pack them beneath all the other more fragile specimens. Once we had collected all that we desired, we headed back to our Socorro base of operation, making one final stop at the museum to reconfirm some of our mineral identifications.

Our experience at the mines of Bingham was indeed fruitful. In a small amount of time, we added a substantial variety as well as some high-quality specimens to our collection. The opportunity to collect such rare minerals as linarite, brochantite, cyanotrichite and others from this historic district was another notch in our collecting belt. And the experience of underground mining gave us an appreciation for the work required to retrieve the mineral specimens we often see online or for sale by dealers. Yes, New Mexico had been good to us on this trip. I'm sure it will not be our last.

FIELD TRIP

THE MILLER Mountain Mine

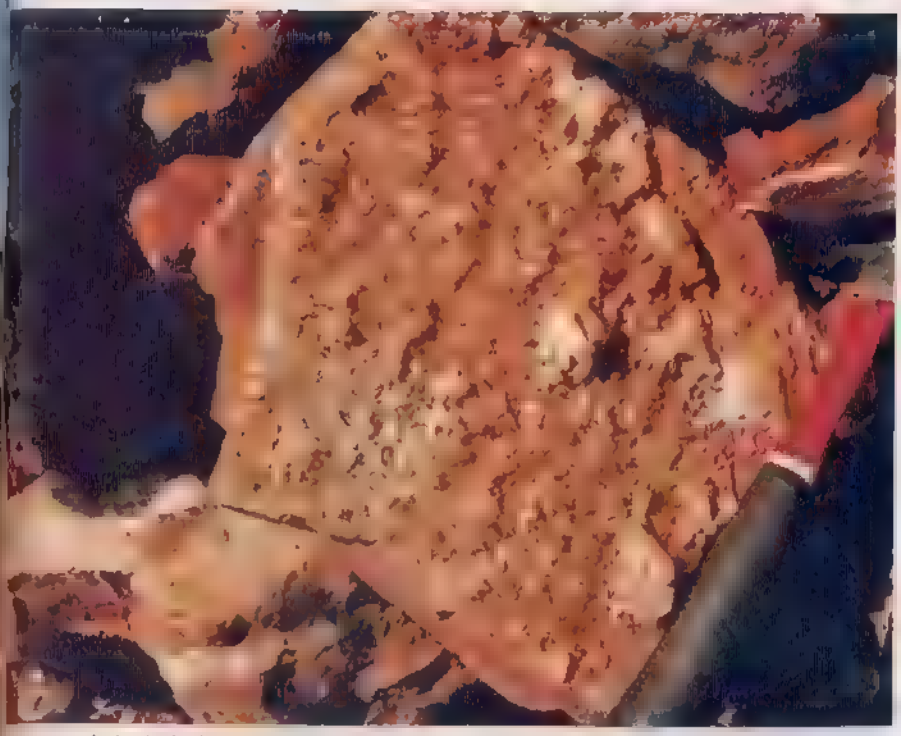
A Crystal Hunter's Paradise

Story and Photos by Kenneth H. Rohn

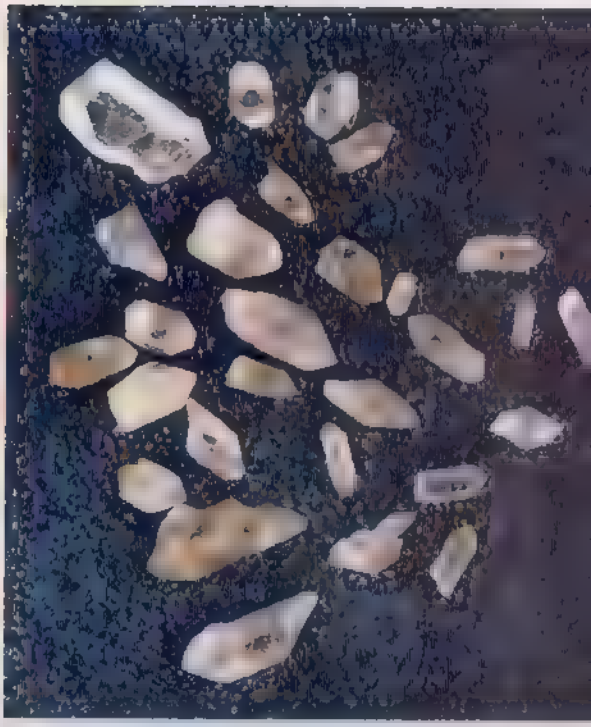
It was a bright, sunny day in December as I made my way south on Scenic state Route 7 in Southwestern Arkansas. My destination was Jessieville. I was eager to try my hand at collecting quartz rock crystals in Garland and Montgomery counties again.

It had been several days since I'd left home during a cold snap, and it was good to see people mowing their lawns, especially in December, when northern Minnesota is usually covered with a heavy blanket of snow.

This iron oxide-coated crystal has the typical hexagonal prismatic form of quartz. It was collected in Garland County.



A chunk of dike wall from the Coleman Mine collecting area shows stubby crystals that have grown perpendicular to the rock.



A selection of water-clear rock quartz crystals was collected from the surface area of the Miller Mountain Mine

State Route 7 is beautiful, with fantastic scenery, but it was not built for speed, particularly when you have a heavy camper in tow. I tried my best not to hold up traffic, but it was inevitable that vehicles backed up behind me on this twisting mountain highway. Whenever I could, I pulled over and let the gathering caravan pass.

I had been in Jessieville once before, a good number of years ago, but either my memory had faded or things had changed considerably since my last visit. Nothing looked familiar. As I drove to the outskirts of town, I did recognize Coleman's Rock Shop (my destination) and its huge yard with numerous display tables laden with crystals and rocks of almost every description.

I arrived at the shop before noon. Ask anyone in town where Coleman's Rock Shop is, if you can't find it. I just followed the signs. After the formalities of inquiring about the Miller Mountain Mine, paying the daily fee ($10 as of this writing) and getting directions, I made my way on over to the mine entrance. Of course, when you're in this country, it's inevitable that you are going to encounter steep grades. The Miller Mountain Mine road is no exception.

I was a bit concerned when I saw how steep it actually is. I shifted down to first gear and towing package, and made my slow way up the long grade. The GMC towing package gives the advantage of more power at a slower speed and higher engine rpm's and works somewhat as a brake. One problem with a pickup camper is that it's top heavy and tends to rock from side to side, even when firmly anchored. If the right combination of bumps is encountered, your home away from home is going to do the twist. I made certain that my gear was battened down and all cabinet doors and drawers were secured properly before attempting the climb. I had learned from earlier experiences. I would not recommend towing a trailer or driving a large motorhome up the grade to the mine.

From Coleman's Rock Shop in Jessieville, it's approximately 8.5 miles over paved road and a few more miles of gravel road to the mine entrance. The people at the shop will give you specific directions and road conditions.

The weather cooperated with me during my late fall stay in the Ouachita Mountains, but it can and does turn cold during December. Snow can put a halt to any collecting. It's a good practice to check the area's long-range weather forecast and highway conditions before leaving home during the cold months.

An interesting and educational stop for me was the Visitors Center and Rest Area south of Harrison on Scenic state Route 7. If you'd like a free vacation planning kit, call (800) NATURAL and say you'd like information on digging for crystals or visit the Web site www.arkansas.com.

I traveled up the mine road without incident and reached the top of the mountain in good time, despite the fact that my speed rarely topped 10 miles per hour. After registering at the mine office, I had an interesting conversation with the lady in charge. She told me with a chuckle that the very first time she collected quartz crystals, she practically had to be dragged off the mountain because it was getting dark. Speaking from personal experience, crystal hunting can become extremely contagious in only a short while.

At the public collecting area at the mine, I met a young geology professor from the University of Northern Kentucky who was on a field trip. She and her students were having a great time collecting crystals. Many of them were digging diligently in the red, muddy material that had been dumped on the tailings area that morning. Others were scrambling about on the cliff-like side of the mountain. Many hundreds of tons of material had been pushed over the embankment by a bulldozer during the course of the mining operation. Some good finds were made there, but I thought it a bit hazardous, what with so many loose rocks on the steep incline. The college students scrambled up and down it with ease.

I should point out that the public is not allowed access to the mine pit. We are, however, permitted to search the very large tailings area. Of course, as in any mining operation, much valuable material can, and does, get lost during transit from pit to processing areas and ends up on the tailings pile or waste dump.

continued on next page

While I was getting ready that day, I heard the bulldozer operator start his engine a short way from my camper. He proceeded up to the tailings area and made a few passes through the recently dumped pegmatite material hauled up from the pit. Any time the dirt is turned over or stirred around, it increases our chances of finding crystals. Naturally, there's a catch to it; the crystals tend to hide in the sticky mass of the pegmatite substance. One could be mere inches away from a prize crystal and never know it. The only way to overcome this is to dig in and feel for solid objects in this mess. I saw several crystals being extracted in just that manner.

During a conversation, one of the students in the group told me that he had found a nice, large crystal on the side of the mountain. He indicated that it was as big as his hand. (From where I stood, on the edge of the precipice, to the valley below, where a dense stand of pines are growing, is at least 200 feet almost straight down.) I didn't see the crystal in question, because it was already packed away in their van. They wouldn't be able to determine its clarity and quality until he had a chance to wash the mud off it.

The pegmatite material from this particular pit isn't always sticky. When it dries out, it has the consistency of fine sand. Rain and wind expose innumerable quartz crystals sitting on the dump; many are fully visible right on the surface. Others are partially buried and are easily discovered when a glint of sunlight on a mirror-surfaced plane gives them away.

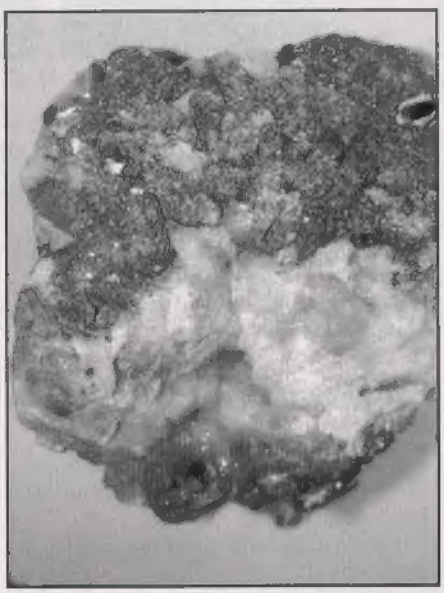
Pegmatite material is actually decomposed granitic rock that gathers in dikes (a rift or crack) in the country rock. A dike can be only a few feet long and a few inches wide or hundreds of yards long and several yards wide. An excellent example is the famous dike containing sapphires at Yogo Gulch in Montana. It's almost five miles long and ranges from 8 feet to 20 feet wide. I have no idea how deep it is. This dike is situated right on top of a hill and consists of decomposed igneous rock in a limestone intrusion.

The crystals have formed in these dikes, growing right on the rock wall, which is, more often than not, of a granite composition. Other crystals will be found mixed in with the pegmatite material, not connected to anything.

When a dirt-encrusted crystal is rinsed off in water, the pegmatite material easily washes away, not like clay, which can stick tenaciously to anything it covers.

The collecting area at the Miller Mountain Mine is quite large. It's situated right on top of the mountain. I stood on the edge by the fence and looked down into the pit, a huge, deep void in the mountaintop. From my vantage point, I couldn't see any activity in the mine, but I knew they were working because I was told material had been dumped on the tailings area that morning.

It was a mild 60 degrees that December afternoon, and the sun was a brilliant orb in a deep blue sky. By the time I got ready and made my way up the slope to the collecting area, old Sol had passed his zenith, but I still had better than four hours in which to search for crystals before the light faded. As I looked back down the hill to the parking area, my camper appeared rather tiny in the distance.



The bottom of this cluster of Garland County quartz crystals is encrusted with mica.

As I walked, slowly studying the ground, I spotted crystals lying right in the road. They had been ignored by everyone who had walked up to the site. I picked up a couple that I just couldn't pass up. They're in excellent shape despite the fact that heavy equipment uses this road, not to mention foot traffic. My rock hammer and collecting pouch hung at my waist. I also had a bottle of water and a 5-gallon plastic bucket, just in case I found something too large for the pouch. My one other tool was an ice pick, which came in much more handy, as it turned out, than the hammer. My camera was carefully wrapped in a towel in the bucket. My tripod was somewhat of a hindrance, but I needed it to record events at the site.

I don't think I was on the mountain more than five minutes when the glint of sunlight drew my attention to the distance. I followed the reflection to a clear, well-formed crystal lying right on the surface. In a matter of minutes, I found more crystals. Some were partially buried and I used my ice pick to extract them. Others were lying conspicuously on the surface, sparkling in the sunlight.

Several of the crystals I collected that day were small, but that did not detract from their beauty. Some were no more than ¼ inch in diameter and better than an inch long. Most had been broken off from the dike wall. Some were doubly terminated twins.

My method of collecting is to walk slowly, facing the sun, often in a crouched position, stopping now and then to watch for a glint of light. A turtle would have no trouble passing me up. Sometimes, I lost sight of a stone and had to back up and watch for the reflection. In this way, I managed to find some very desirable crystals. The majority of those I picked up are no larger than the diameter of a pencil, but their clarity and beauty are magnificent. The tailings/collecting area is rugged, with boulders and big clumps of dirt. A sturdy pair of shoes is recommended here.

During my searching, I often picked up two and sometimes three crystals lying right at my feet. In one pass across the tailings area, I was walking in the path that the 'dozer had made when I noticed a dull glint at the edge of the furrow nearest me. I picked up a mud-encrusted crystal. If I hadn't been going extremely slowly and examining every inch of ground within my viewing radius, I most certainly would have missed it. When I rubbed some of the dirt away, I found it was a beautiful doubly terminated rock crystal, ⅝ inch in diameter and 2½ inches long. On three of its planes, it has the beginnings of smaller crystals that never formed completely. Both pyramidal terminations are encrusted with red iron oxide, but the center is water clear, revealing inclusions in its internal structure, mere bubbly phantoms resting at a slight angle in the center of the crystal. I didn't learn how really beautiful this stone is until I got back to the camper and rinsed it off. A nice gemstone of perhaps 2 or 3 carats could be cut from one end, which appears flawless under magnification, but it will remain as a cabinet specimen.

Doubly terminated quartz crystals (twins) are often found lying suspended

in the pegmatite. Why and how this happens, and how they formed this way, is somewhat of a mystery; but then so much of the history of Earth's geology is shrouded in mysteries. Pegmatites—particularly the ones I've worked in—as a rule have always been packed solid with the typical claylike rock substance that they're made of. As a matter of fact, it's often so hard that a pick or gad must be used to loosen it before the crystals can be removed. In the process, many are broken. At this mine, the hard work has already been done for us.

I was making good progress, losing

Doubly terminated and Japan Law twin crystals can be displayed intact or faceted into beautiful jewelry stones.

all track of time, and my pouch was beginning to feel a bit heavy. When I finally looked at my watch, it was well past 2 p.m. I had missed lunch. The excitement of the hunt was so intense that I didn't even feel hungry. I took a drink of water and moved on. I had a candy bar with me in case I should get hungry later.

I searched at random on the tailings dump, picking up several very nice crystals of good size in the process. I saw no need to try digging for them. I was finding a good deal of water-clear crystals. Many would rival the Herkimer diamonds of the East Coast for flawless clarity. Some have perfect hexagonal pyramidal points.

I managed to find a few Japanese law twins during my search. For those not familiar with this phenomenon, Japanese law crystals have a smaller crystal growing off the side of the host crystal that protrudes at a slight (60 degrees, sometimes more) angle. I found one that is closer to 90 degrees, almost making a perfect cross. This is quite rare. The host crystal measures ¾ inch from point to point and ⅛ inch in diameter. The adjoining crystal is a bit smaller. The host crystal is not doubly terminated and was no doubt broken off a larger mass of crystals on matrix.

As I was setting up my tripod to take a few photos, I noticed a thin, dirt-encrusted red rock about 10 inches long and 3 inches wide lying right next to my bucket. There was nothing unusual about it, but I picked it up. It was lying upside down, and when I turned it over, I saw a heavy cluster of stubby rock crystals poking through the mud. When I rubbed some of the mud away, I realized that I had a good cabinet specimen in my hands. The crystals are gathered in a large mass on this thin section of the granitic dike wall. An underlying layer of milky quartz is bonded to the granite. I didn't know how good it was until I washed it off at the camper later that afternoon. It's covered with literally hundreds of stubby, clear rock crystals. When I took it to my darkroom and examined it under long-wave ultraviolet light, only two tiny areas on the side of the rock fluoresced a pretty violet. The crystals themselves didn't show any change.

I also found some milky white crystals, which went into my pouch along with the clear ones. They're so dense no light rays are transmitted through them.

A number of crystals found at the Miller Mountain Mine have thin patches of iron oxide on them that cannot be rubbed off with one's fingers, but the vast majority are clear. A bath in oxalic acid would easily clean off the oxide. If you use acid, take the proper precautions: Protect your eyes with a good pair of goggles, and above all, keep such chemicals locked up and away from children!

The afternoon passed too swiftly, and before I realized it, the sun was hovering over the tree line in the west. I decided that I'd better call it a day. The shadows were long and it was getting hard to see the crystals. The University people were on their way out and waved at me as I walked down the hill to my camper. I had a very good collection of crystals to show for my efforts. It had been a most productive day.

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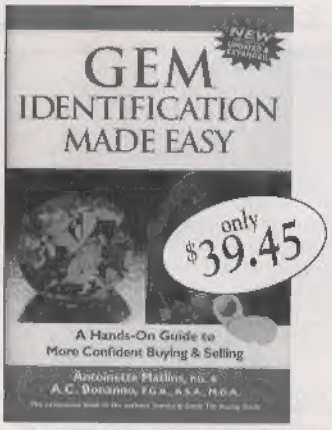

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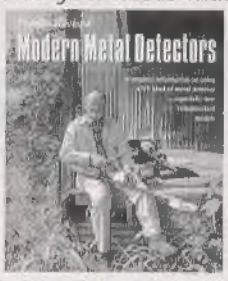

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ON THE ROCKS

New Life for Uranium Mines?

I see the price of uranium metal is on the upswing, nearly doubling in a couple of years. That means some of the old uranium mines in the Four Corners area of Colorado, Arizona, Utah, and New Mexico may be reopened. All the nasty environmental problems associated with mining radioactive minerals will follow. While radioactive minerals are not among the most popular collector minerals these days, these mines did produce some quite interesting scientific species and an occasional prize winner.

If mining resumes here, at least we have a better understanding of the hazards than we did back in the 1940s and '50s. Radioactive waste will be buried, usually underground at old mine sites. And miners will wear dust-proof equipment that will protect them as never before.

On a personal note, thanks to that earlier uranium boom, there's now a mineral called bobjonesite. This calcium vandium sulfate formed in a petrified wood log buried in the Shinarump conglomerate formation that is fraught with secondary uranium minerals. The original uraninite was decomposed over millions of years and the end products were carried along in the sediments that make up the Shinarump.

Bobjonesite was found a few years ago in an abandoned mine that produced uranium and vanadium, the North Mesa #5 mine in Utah, which has since been sealed because of the radioactivity hazards. Bobjonesite is really rare; there are only a dozen or so known specimens. Of course, if some of the mines in that area are reopened, who knows what might turn up. I'd love to see more bobjonesite!

* * *

I suspect one reason our hobby is having trouble attracting youngsters these days is that the schools are doing a woeful job of teaching the earth sciences, particularly in the lower grades. So it was with some pleasure that I noticed an offer for Geokits in an older issue of *National Geographic*. This is part of *National Geographic*'s educational outreach division, which provides educational videos and materials on topics including Dynamic Earth, Rocks and Minerals, and Astronomy. The Geokit offers teaching units on science and natural history packed with articles, maps, transparencies, and more, all organized in a three-ring binder. To learn more about Geokits, call (800) 368-22728.

While on the subject of teaching materials, one source of out-of-date books on geology, mineralogy, minerals, gems and the like is an outfit in California appropriately called Rocks of Ages. John and Linda Stimson search book stalls, dealers' shelves, shows, and every possible source for older books on these subjects. They produce a catalog four times a year that lists something like 700 titles by author. The size and number of maps and photos are given, along with a short paragraph about the subject matter. The condition of the book is described so you can judge whether you want to obtain it.

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* * *

As if this writer doesn't have enough to do, *Rock & Gem* has been invited to be a part of a new advisory board being put together by the Gemological Institute of America (GIA). This organization, based in Carlsbad, California, has become the industry leader in gemological education and research. Part of that effort involves the identification of new gem materials, research into gems, classes in gem identification, correspondence courses, and gem marketing. Their publications provide detailed information on gem localities, gem studies, and the gem market.

The new blue aquamarines found on Mount Antero in 2004 are Colorado's best ever.

On occasion, the GIA organizes and hosts an international Gemological Symposium, a function first organized 30 years ago. The next Symposium will be held just over a year from now, Aug. 27-29, 2006, in San Diego. Titled, "Navigating the Challenges Ahead," the GIA's fourth symposium coincides with the GIA's 75th anniversary! With all the advances in the science of gems, a comprehensive symposium will give industry leaders, academics, innovators, and scientists a wonderful opportunity to share research and knowledge in this fast-growing science. Business leaders and students will benefit greatly from what comes out at this next symposium.

As part of the planning for this signal event, the GIA is organizing an Industry Advisory Board, which will participate in the planning and promotion of the symposium. *Rock & Gem* was invited to participate on this board, and I was asked to represent the magazine.

As meetings are held and as symposium time approaches, this column will offer information for those interested in being a part of this very special event. Meantime, if you are involved in the gem industry in any way, save these dates in anticipation of this very special opportunity.

* * *

In August 2004, Rick Tekancic was at it again, banging away at the pegmatite outcrops of Utah's Wah Wah Mountains in search of red beryls. He had been reasonably successful on past digs, but I doubt anything prepared him for his discovery.

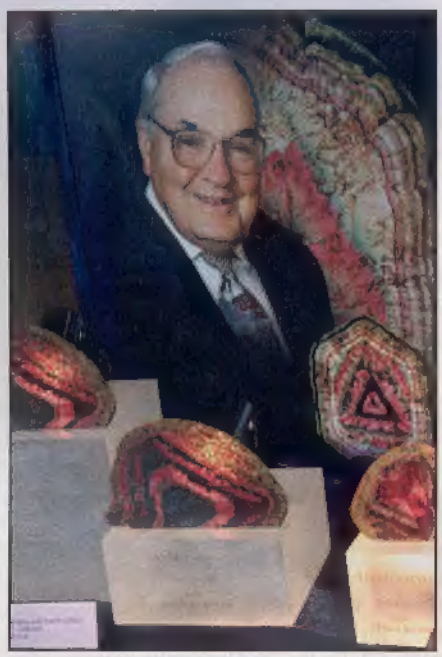
The find occurred while Rick was reworking a spot where he had already found a pocket in 1995. He hammered away at the solid granite and quartz and finally broke into what he thought was a nice pocket. To his great pleasure, the pocket gradually opened to 14 feet wide and extended at least 20 feet into the mountain. The pocket was, like most granite pegmatite pockets, filled with decomposed granite, clay, feldspar, and the like, so he did not see what was there at first. But nest-

ed in that cavity and detritus were superb, large quartz crystals, immense for the deposit and better than any previously found at Mount Antero.

Rick and his partners Brandon Henderson and Stuart Gehrke dug into the rubble of the "Subway Pocket," recovering fine specimens as they went. Imagine their excitement. Since we received their press release in September 2004, not much has been heard of this quartz find, though I expect we will see the specimens at future shows.

If you attended the Tucson Gem & Mineral Show, you undoubtedly saw the fantastic aquamarine and smoky quartz specimens of feldspar from Mount Antero on display at Tucson. The aquamarines are the most amazing blue crystals I've ever seen from this old locality, as thick as your thumb and up to 6 inches long, *and* they are on matrix!

The aquamarines were mined in July 2004 at an elevation of 13,000 feet. I've been in mines at 11,000 feet, where a few strokes with a single jackhammer leave you panting for breath. To dig hard at 13,000 feet would certainly be much tougher! The discovery of these amazing aquas prompted the miners to name the find Diane's Pocket. It's on the Claire Mary Ellen Claim #1. I feel a kinship to this find, since my grandmother was named Mary Ellen!



Richard Liddicoat started the GIA library, which is now under the direction of Dona Dirlam. Dona was recently honored for her work there.

I've seen plenty of aquamarines from Mount Antero, including those displayed at the Denver Museum of Nature and Science. These new gemmy hexagons with a lovely blue color are certainly the best I've ever seen, and the folks I talked to at the Tucson Show, some of them long-time museum curators, agreed with me that these have to be ranked as the best from Mount Antero and from Colorado. Let's hope the miners strike a "Diane's Pocket #2" this summer!

* * *

It's always fun when you learn that a good friend has been honored with a special award. Such is the case of Dona Dirlam, director of the Richard T. Liddicoat Library and Information Center in Carlsbad, California. Dona has been honored with the GIA's Distinguished Achievement award. This is the highest award the GIA can confer, and it recognizes Dona's 24 years of successfully managing a gemological library that is unrivaled in the gem world!

In the 30 years of the GIA's existence, this is only the 10th time the award has been made. What I find exciting about this award going to Dona is the fact that she is one of those behind-the-scenes persons who not only makes a difference, but is part of the cadre that is the foundation of our science and hobby. Librarians seldom get the recognition they deserve, so this is a really special honor for Dona, and certainly well deserved! Congratulations, Dona!

* * *

With all the writing I do, it is inevitable that I make mistakes. My latest mistake was spotted by my good friend Dave Douglass, premier scientist and now mineral dealer. Dave is an expert in Material Science and Engineering and worked at the University of California, Los Angeles, until he retired. He enjoys minerals and is a dealer at many shows in the west.

My thanks go to Dave for pointing out that when I wrote about realgar altering to orpiment, I was flat-out wrong! The alteration product that makes an orange powdery coating on realgar isn't orpiment at all, but pararealgar! This alteration product is a dimorph of realgar, meaning it is simply a different, but entirely valid, form of realgar.

Now how did Dave know that? Because working with his associate Chichang Shing and with Ge Wang of Ohio State University, he tested the realgar mineral alteration and proved to be realgar's dimorph pararealgar.

The problem is that realgar varies in sensitivity to different forms of light. I think every collector knows realgar is light sensitive. Most light sources (sunlight, artificial light, etc.) will cause the realgar to break down and produce pararealgar, which is so often mistaken for orpiment. Dave and his associates published their findings in the *American Mineralogist* in 1992, so I should have been aware of this fact.

* * *

Those of you who attend the East Coast Gem, Mineral & Fossil Show in West Springfield, Massachusetts, each August may be aware that I was a regular speaker there for 10 years. I announced that my talks in 2003 would be my last at that show. How wrong I was. Circumstances have made it possible for me to attend that show again on Aug. 12-14, 2005.

The show is held on the Eastern States Exposition fairgrounds, easily reached from Intestate 95 in Springfield. Just cross the river going west. Parking is free and so is admission to the show, so readers have no excuse for not coming to hear my talks.

The collection of Harvard University will be the featured display at the show. If you know anything about the history of mineralogy in this country, you know Harvard scientists were in the forefront of mineralogy for a couple hundred years. The Harvard collection has some absolutely superb minerals in it, including some of the best from New England.

The Harvard gold collection is internationally famous, so that will be the subject of one of the talks I will give at the show. Remember, Harvard boasts the largest known ram's horn gold wire in existence!

Another of my talks will be "Does Bisbee Have a Future?" You all know Bisbee was one of the world's great copper camps beginning in the 1870s and produced superb mineral species—more than 300 of them—right into the latter half of the 20th century. The deposit is now closed, but if specimen collecting becomes an important recovery business, the area could have a great future! The discussion will feature some of the mineral specimens collected by Ben Williams, the very first mining superintendent of the Copper Queen Mine back in the late 1800s!

The third talk will cover "Famous Beryls of the World." This remarkable pegmatite gem has been mined in every major—and some minor—country of the world. The talk will describe visits my son and I made underground in the emerald mines of Colombia, South America, and the successful digging of red beryls in the Wah Wah Mountains of Utah on several visits.

If you are at all interested in minerals, visit the East Coast Show, where you'll find some top dealers and classic mineral displays from Harvard, and even hear a talk or two about some of my travels. It's always a good chance to rest up from walking the show floor!